COMPARISON OF AURAL AND VISUAL INSTRUCTIONAL METHODOLOGIES DESIGNED TO IMPROVE THE INTONATION ACCURACY OF SEVENTH GRADE VIOLIN AND VIOLA INSTRUMENTALISTS

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The purpose of the study was to compare two instructional methodologies designed to improve the intonation accuracy of seventh grade violin and viola instrumentalists. The collection of data was in regard to (1) instructional methodology: aural and aural/visual, (2) performance tasks: A, B, and C; (3) individual pitches (seven from each of the music tasks), and (4) differences between instrument groups: violin and viola.

Sixty-eight seventh grade string students from three string classes of two middle schools were randomly assigned to two experimental groups: (a) aural and (b) aural/visual. The instructional period was implemented daily in ten-minute sessions during twenty days by the orchestra instructors of each school.

A pretest-posttest format was used to determine if there were any changes in the subjects' intonation accuracy from prior to after the instructional phase was implemented, and if these

changes could be attributed to any of the methodologies. The testing material used on both testing sessions included three performance tasks composed of seven notes each. Subjects were recorded on both testing occasions.

The data were the scores of absolute pitch deviation, measured in cents from equal temperament, from the pre- and postest; these were treated with analysis of variance. The ANOVA on the posttest scores indicated a non-significant difference between the instructional methodologies in their effectiveness to improve the subjects' ability to play in tune.

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CHAPTER 1

INTRODUCTION, BACKGROUND OF THE STUDY, RATIONALE, PURPOSE, RESEARCH QUESTIONS, DELIMITATIONS, AND DEFINITION OF TERMS

Introduction

It is a recognized fact in the music education community that the lack of accurate intonation is an ever present problem in the musical performances of vocal and instrumental school ensembles. It is also a fact that the teaching and development of correct intonation in young students pose a pedagogical challenge to instrumental teachers and ensemble directors (Bencriscutto, 1965; Brick, 1983).

According to Stegeman (1967) no phase of music performance has been so sadly neglected as the study and practice of music intonation. Laycock (1966) proposed that several elements affect intonation in the orchestral classroom setting. These include factors, such as: (a) changing environmental conditions like room temperature and humidity which have an impact on the accurate reproduction of pitches by certain instruments; (b) the instrument itself can be a source of intonational problems if the general adjustment of the instrument is out of proportion (bridge too high in relationship to the fingerboard, soundpost set inaccurately, separation of the strings too narrow or too wide), (c) the student, lacking pitch awareness, not possessing the ability to control the instrument, and being preoccupied with other details of string playing, give little or no attention to playing in tune; and (d) the role of the teacher in instilling intonation concepts and pitch discrimination principles on the students.

It is the string instructor's responsibility to make a diagnosis of the causes of faulty intonation in an ensemble, and provide corrective measures to improve the group's pitch deficiencies. The implementation of a remedial course of action should have the goal of creating in the student's musical consciousness an awareness of pitch fluctuation through the development of pitch discrimination.

Intonation is the reproduction of pitches instrumentally or vocally in conformity to a tuning standard that as been accepted as the norm (Randel, 1986). Correct intonation implies that all notes played or sung are exactly on pitch according to the chosen standard. Conversely, incorrect or inaccurate intonation results when the notes produced are above or below their proper pitches.

Pitch discrimination is the ability to perceive the accuracy of a note and determine if it is above or below its intended target. This aural skill enables the musician to make the necessary corrections to pitch when a deviation is detected. For students to play in tune, or match the accepted standard, it is crucial that they possess the competence to make subtle pitch discriminating judgements, and the skill to execute fine tuning adjustments.

Intonational accuracy is an attainable, or learnable, skill. Music educators and educational psychologists share the view that pitch discrimination, like any other academic or motor skill, is acquired and, therefore, subject to improvement (Heller, 1969; Lundin, 1967; Porter, 1977).

Evidence is presented in the investigations by Graves (1963), Lundin (1963), and Cuddy (1970) that pitch discrimination abilities may be improved through systematic training. Cohen (1984) asserts that a student’s potential to discriminate pitch can be permanently impaired if the student is allowed to play out of tune without the proper guidance or an understanding of pitch relationships.

The students’ adequacy to learn the rudiments of string playing, including the notion of intonation, can be positively or negatively affected by the methodology or teaching approach with which these musical concepts are taught. Klotman (1981) maintains that a well structured instruction with a sequential presentation of concepts and skills will yield great dividends as the student endeavors to achieve proficiency in performance and attain intonational correctness by developing pitch discrimination. Albert (1967) asserts that school performance groups do not receive frequent nor systematic instruction in pitch adjustment or even in how to listen discriminately.

Background of the Study

When we listen to music, we hear sounds and other elements of a composition not as isolated, disconnected units, but integrated into patterns, in such a manner, that the perceptual experience of a musician encompasses more than just the sensory registration or recognition of single musical events (i.e. rhythm, pitch, timbre, etc). “Sound elements are heard in context, organized in pitch and time, and are understood in terms of their functions within that context” (Krumhansl, 1990, p. 3).

Because notes or pitches sounding by themselves do not possess musical meaning, the absolute pitch of any particular tone is less important to the musician or the listener than the intervals it forms with neighboring pitches. As a result, the function of a given pitch is established by its relationship to another pitch. When the notes of an interval are placed in context melodically (contiguous) or harmonically (simultaneous) they produce a sequential or synchronous set of sounds that, when heard, are recognized and understood by the tonal memory of the listener. Tonal recognition is what gives meaning to the sounds of a melody or a symphonic work, adding enjoyment to the musical experience.

Musicians and psychoacousticians have been keenly interested in exploring the effects of sound on the human mind. This is evidenced in the abundant experimental research

investigating musical pitch that has been carried out in the last few decades. Researchers have examined many variables that affect the processes of pitch perception and have attempted to establish how these relate to performed pitch accuracy. Some variables have been manipulated to determine if performed pitch accuracy is attainable by everyone involved in musical endeavors, or if there are prerequisites or special conditions for the achievement of this musical skill.

The results of these investigations have provided valuable information concerning the intonational tendencies of string instrumentalists and have served as factors in the formulation of strategies and instructional techniques for the teaching of string intonation. The most salient research findings indicate that: (a) there is a marked tendency of string instrumentalists toward sharp intonation (Lader, 1977; Papich & Rainbow, 1974, Salzberg, 1977); (b) flat deviations in pitch are more readily detected and corrected than sharp mistunings by advanced instrumentalists (Papich & Rainbow, 1974; Salzberg, 1977); (c) tuning accuracy may be affected by the direction from which the pitches are approached (Edmonson, 1972; Madsen, 1962, 1966, 1974); (d) musical training significantly increases the ability to identify the existence and direction of slight changes in pitch (Madsen, Edmonson, & Madsen, 1969; Elliott, 1974; Geringer, 1983; Duke, 1985); (e) music discriminating abilitiess are developed by very young children (Webster & Schlentrick, 1991; Costa-Giomi, 1987; Forsythe and Kelly (1989) (f) pitch discrimination and the ability to play in tune improves with age (Geringer, 1983; Moore, 1993); (g) instructional approaches influence how musical concepts are learned (Kendall, 1988; Moore, 1993; Carmody, 1989), (h) the use of vocalization techniques improved pitch discrimination and tonal memory (Elliott, 1974; Harris, 1978; Schlacks, 1981); (i) accompaniment in the form of harmonic context or unison playing enhances pitch perception ability (English, 1985; Kantorski, 1984; Bergonzi, 1991; Garman, 1992); and (j) there is a possible converse relationship between the perception or discrimination pitch and performed pitch accuracy (Geringer, 1976; Geringer & Witt, 1985; Madsen, Edmonson, & Madsen, 1969; Ward and Martin, 1961).

Sample populations for these studies have been drawn from public schools (elementary, middle, and high school), college/university level musicians, and professional instrumentalists. The experiments focusing on early high school and middle school students were mostly in the setting of the band classroom, investigating intonational variables as they apply to wind or brass instrumentalists (Duke, 1985; Harris, 1978; Miles, 1970). The research efforts related to string intonation with students of this age group are scant (Eisele, 1985; Carmody, 1989).

Eisele (1985) investigated the effect of computer assisted instruction (CAI) on junior high school violinists and violists in grades 6, 7, and 8, that were in their second through fourth year of string study. Subjects were randomly assigned to two groups, one experimental that participated in CAI designed to improve pitch perception and finger placement on their respective instruments, and a control group that received traditional string class instruction only. Results indicated that gains in the posttest for pitch perception were significantly better for the CAI students than for the control group subjects, however, there were no significant differences between groups in terms of intonation performance.

Carmody (1989) studied the effects of performance in chamber music ensembles on junior high school string players' intonation and attitudes toward music. Students involved with chamber music were judged to be significantly more in tune than those who were in large ensembles only.

If we consider the tremendous growth that string programs in public schools have experienced in the last three decades, and the huge number of students that are involved in the performance of a string instrument, it is surprising, if not dissapointing, to find so little research done with string students of middle school and early high school age. It is no only evident, but pressing, the need to conduct more systematic and controlled research addressing intonation variables that relate to the development of pitch discrimination and intonation ability in young string players.

Intonational Components

According to Garofalo (1996) pitch discrimination is the ability to detect small discrepancies or fluctuations in pitch. This skill, as an element of musical perception, is fundamental for the awareness of pitch fluctuation and the development of intonational accuracy in performance

In the body of literature three dimensions emerge as the major components identified in the process of developing accuracy in performed intonation. These dimensions, which involve abilities that interrelate with each other, and produce the desired result of performing notes in tune, are the: (a) aural (hearing), (b) visual (imagery), and (c) kinesthetic (fine psychomotor skills) components (Bergonzi, 1991; Jacobs, 1969; Sogin, 1986). For the purposes of this study training in only the aural and visual elements will be addressed.

The Aural Component

The aural aspect of intonation deals with the “what” of intonation, or the musical sounds or pitches involved in a musical composition. It determines how these are perceived by the human ear and processed by the human mind. Aural development is indispensable to accomplish the task of playing in tune. Without a properly trained aural sense all activities in the performance of an instrument would become mechanical and void of musical significance.

Aural ability, essential to detect discrepancies in pitch, is the most important competency that a young instrumentalist can acquire. Authors of string issues and pedagogical concerns recognize that the ear is the guiding force in the task of producing notes accurately in tune.

Researchers have concluded that the ability to discriminate pitch inconsistencies is a prerequisite to accomplish the task of playing in tune (Salzberg, 1977), and that string players must have the ability to make the corresponding adjustments swiftly as they perform (Sogin, 1987; Galamian, 1985; Flesch, 1939).

Performed pitch accuracy involves not only the ability to precisely determine the pitch of a note by perceiving small pitch deviations from an established norm, but also the use of fine motor skills necessary to make the required adjustments when correcting that pitch. These two skills are interrelated and dependent on one another. The first must be present in order for the second to take place. Also, in making adjustments to pitch it is fundamental that string players be able to determine the direction, high (sharp) or low (flat), in which a pitch correction or adjustment should be made.

Research studies concerned with the evaluation of pitch discrimination and intonational accuracy have addressed the instrumentalist's or singer's aural ability (Bergonzi, 1991;

Geringer, 1977; Geringer & Witt, 1985; Meyer, 1993; Smith, 1991) . This is the capacity that will ultimately enable the musician to detect the errors or fluctuations in pitch and be the guide for any needed corrections or adjustments.

The Visual Component

The visual aspect of intonation in string playing addresses the issue of “where” in the instrument are pitches produced, as well as the ocular discrimination of produced pitches by means of charts, graphs, and other electronic equipment, i.e. strobo tuners. The “where” of pitch production refers to the instrument’s fingerboard in which the pitch points that will produce the pitch a note are observable to the player.

The concept on correct intonation as it applies to string instruments is based on the premise that the calculations for stopping the string to produce different pitches should be predetermined, or “learned”, a priori by the string player, so that when a finger is placed over the string on one spot of the fingerboard it will consistently produce the same pitch on repeated trials. The kinesthetic action of "learning" to place the fingers on the string must be guided by the ear of the player. Any adjustments necessary to correct a pitch should be the result of careful listening (pitch discrimination), rather than the outcome of mere mechanical figurations of tactile correlations. Galamian (1985) asserts that the sense of touch (left hand) must be guided by the ear to produce the needed adjustments.

To determine the finger placement on the string a player must understand how a string should be stopped to produce half tones and whole tones. The strings of a violin, viola, cello, and double bass are to be divided into smaller lengths in order to produce pitches higher than that of an open string. The ratio for stopping the strings to produce a half step is 1/18 and a whole step 1/9 of the total vibrating length of the string. This ratio remains constant regardless of the area of the string where the player is producing the notes. Thus, as the notes on a string get higher in pitch, the available length of vibrating string is less, and the separation of fingers to produce whole and half tones is smaller. To illustrate this concept we need to examine the frets on the fingerboard of a guitar and observe that in order to produce higher pitches each fret is slightly closer than the preceding one as they go toward the center of the instrument's body. Frets produce half steps and are placed in such a way that when a player stops the string the ratio of vibrating string length to pitch, 1/18 for a half step and 1/9 for a whole step, is precisely followed.

String players are able to determine the pitch location of a note by listening and adjusting their fingers as they are placed on the fingerboard of a string instrument (Smith, 1985, 1987; Bergonzi, 1991). This skill, however, is not well developed in beginner players, or perhaps not developed at all. To circumvent this deficiency and allow first year students to engage in string playing still achieving some degree of acceptable intonation, the use of finger placement markers (FPMs) has been proposed and implemented. FPMs act like the frets of a guitar in that they show the young player the points on the fingerboard where pitches are produced (pitch points) and the spots where the left hand fingers should be placed to perform those pitches. According to Dillon and Kriechbaum (1978) the use of FPMs is acceptable and desirable in the beginning stages of learning, but should be promptly removed as soon the student is able to understand the production and adjustment of pitch.

A performer can also visually ascertain the accuracy of the produced pitches by observing the fixed frequencies of a electronic tuning device (Albert, 1967; Ericksen, 1975; Graves, 1963), and by using other means of visualization techniques like electronic graphs (Heller, 1969), computer generated charts and pitch matching graphics (Eisele, 1985; Meyer, 1993).

Rationale for a Visual Methodology

In an early assessment of the role of the senses of hearing and seeing in the musical training of students Mursell wrote: “musical hearing and musical seeing are essentially and reciprocally related. The eye and the ear can and should support one another”, thus, establishing the importance of incorporating the visual element in the training of young players (Mursell, 1953).

Graves (1963) compared three methods for the improvement of intonation in the performance of instrumental music: aural, visual, and what he termed conventional. He makes the recommendation of further study to determine if the visual method would produce more significant gain if subjects were exposed to visual feedback more frequently than they were permitted in his experiment.

Heller (1969) proposes that the use of two sense modalities (sight and hearing) aids the human learning process. In his study the continuous and immediate bimodal feedback (aural and visual) was more effective than auditory feedback alone. He adds that musicians may be reluctant to consider the use of accurate visual reinforcement of auditory performance concepts in training situations, but evidence indicates that immediate and accurate visual reinforcement can improve a student’s performance to a higher level than that achieved by conventional means, and if this improvement transfers to performance without visual aid, musicians should consider using such a device for training purposes.

Kendall (1988) evaluated two modes of instruction to establish their effectiveness on the teaching of aural musicianship and instrumental performance: (a) modeling, that included aural and kinesthetic activities and (b) comprehensive, that comprised aural, kinesthetic, and visual strategies. The findings of the study indicated that learning sequence in music is cyclical or spiral in that "aural, kinesthetic, and visual skills are identified, arranged, repeated, and expanded to facilitate effective music learning (Kendall, 1988).

Forsythe and Kelly (1989) assert that both artistic and functional purposes can be served by stimulating several senses simultaneously during the teaching process, particularly, and most commonly, the visual and the aural senses. The findings of their investigation suggest that the use of visual cues paired with melodies is generally an effective aid to aural discrimination among fourth-grade subjects. Bergonzi (1991) stipulated that a tactile/visual reference and an aural reference operate separately and in combination within the process of string intonation performance. Smith (1987) found that the use of finger placement markers was detrimental to the successful acquisition of intonational skills since their removal caused subjects to be confused and were not able to overcome the situation of not having the aid of these visual devices. This research findings suggests that the visual aspect of intonation training should be done perhaps away from the instrument not on the instrument itself.

Starr (2000) warns that the use of visual aids in the form of finger placement markers is intended to help the young student shape his left hand properly as well as be an aid to visually guide the student’s fingers to the spots on the string where the notes will be produced in tune. He emphasizes that it is the teacher’s responsibility to assist the student in developing both a sense of “mental placement” and of “mental reflection” on the action of finger placement that the player makes to perform musical notes.

The investigators and authors mentioned above have established that aural training is indispensable for the improvement of instrumental intonation accuracy, however, they also agree that visual instructional strategies enhance the learning of musical concepts, especially the acquisition of intonation skills when paired with the sound stimulus. The visual aspect of pitch instruction in the present study is addressed by the use a visual aid that demonstrates the pitch placement points where the stopping of the string must take place to accurately produce the notes and their corresponding pitches.

The kinesthetic action of a string player involving the placement of left hand fingers on the fingerboard, is the direct result of effectively training the aural and visual elements of pitch discrimination. Jacobs (1978) concluded, after her study with middle school students, that many young string players tend to produce the pitch of a note guided only by the kinesthetic or tactile processes of left hand finger placement without any reference to the aural or visual aspect of string playing. A more effective and accurate process needs to incorporate a referential process for the production and modification of pitch, a working knowledge of interval distances, scale construction (tone and semitone patterns), semitone location on the fingerboard, and some theoretical concepts that affect intonation (Barrett, 1976).

Rationale

Playing in tune is one of the most important skills a young string player can acquire. Smith (1985) states that the development of performed pitch accuracy of string students is a topic of great concern to string educators and that little experimental research exists that sheds much light on this crucial aspect of string instruction (p. 13). The aural element involved in the development of this skill is the most consequential factor in the mastery of this integral part of musicianship. Of all the studies that have investigated the aural component of intonation, none has made use a teacher modeling-student imitation teaching strategy for the improvement of intonation, nor has any used a visual prompter, away from the instrument, as a means to improve intonation.

The present research investigated the significance of an aural training involving an interactive modeling strategy along with verbal instruction when dealing with the auditive part of intonation; and a visual approach using a visual aid in the form of a violin/viola fingerboard with movable dots to establish the location of pitch points on the string. Smith (1985, 1987) and Bergonzi (1991) used finger placement markers attached to the instrument fingerboard to address the visual context that facilitates the measurement of the distance between fingers. Their results presented opposing findings.

Research studies that have included string students from middle school age as subjects are sparse (Eisele, 1985; Carmody, 1989). A research-based knowledge is needed to better understand how pitch is perceived and processed by middle school age students, and in which ways pitch discrimination can be impacted to provide young string players with reliable means to attain performed pitch accuracy on a consistent basis.

Directors of vocal and instrumental ensembles in schools face the difficult challenge of training young musicians to play or sing independently in tune. It has been advocated that intonational accuracy in performance is the result of careful planning on the part of the teacher that should include the development of aural skills, a visual training, and a kinesthetic learning process. According to Cuddy (1970) and Lundin (1967), the ability to play in tune is an attainable skill that may be improved through systematic training.

The pedagogical implications of correctly instructing young players in the early stages of learning carries great importance. The present research provides the string teacher and the string student the opportunity to explore pedagogical tools that can effectively demonstrate the finger placement on the string to produce the notes contained in the span of first position. The clear imaging of the location of a note on the string will be of benefit to middle school age string instrumentalists for this provides a means of determining with exactness the correct placement of left hand fingers.

A kinesthetic approach (by rote or feel) to teaching and learning to play an string instrument offers a great beginning thrust, but it will have severe limitations if higher thinking skills are not incorporated in the process of understanding and processing pitch relationships (Dillon & Krieckbaum, 1978). The main objective of the study is to present the concept of pitch distance relationships of the notes that form an interval, and how it applies to finger patterns and produces the consequential pitch precision.

As expressed by many young string players to this researcher, students have the need to know when they are in tune and when they are not. They want to feel secure in determining the direction of the pitch correction that must be implemented. Having the confidence of knowing how to measure the distance involved in producing the note pitches of an interval will help ameliorate these insecurities.

Purpose

The purpose of the study was to make a comparative evaluation of two instructional methodologies (aural and aural-visual), designed to improve the intonational accuracy of seventh grade violinists and violists.

The aural methodology incorporated in the instructional phase the technique of modeling by the teacher with the subsequent imitation by the students. The teacher modeling consisted of the performance with correct intonation of the notes that form an interval or a series of intervals. It also included the verbal element necessary for the explanation of concepts and to provide directives during the interval exercises period.

The aural-visual methodology comprised: (a) all the activities of the aural methodology, and (b) the procedures proper to a visual methodology which included the use of a visual stimulus in the form of a visual aid. This was the physical representation of a string instrument fingerboard with movable dots that were placed on the strings to visually demonstrate the pitch locations and the intervallic distance relationship of two or more notes.

Research Question

The study was designed to answer the following research question: Which methodology is more effective in actuating an improvement in the intonation accuracy of seventh grade violin and viola instrumentalists: (a) an aural training that incorporates interval exercises implemented through teacher demonstration-student imitation cycles, or (b) an aural/visual methodology that encompasses the activities of the aural training combined with a visual teaching strategy that makes use of a visual aid in the form of a violin/viola fingerboard that indicate the pitch points on the strings to facilitate left hand finger placement?

Delimitations

1. Findings of this investigation do not include cello and bass since these instrumentalists would need to shift

into different positions to be able to play all performance tasks.

2. This investigation did not incorporate vibrato in its experimental phase. String pedagogues have advocated that vibrato, due to the oscillating nature of the sound it produces, is a great tool to make minor adjustments to pitch, however, its proper execution is beyond the technical scope of 7th grade string students.

3. Shifting was not included in the study to avoid inaccuracies in pitch due to imprecise shifting and not to the lack of understanding of finger placement and pitch relationships.

Definition of Terms

1. Pitch. (a) In physics, the perceptual attribute of tone height, described along a single dimension that extends from low to high. (b) In tonal music, the label of a tone that specifies its register and its exact spelling, and thus its role in a key system. In the context of this study pitch

is the psychoacoustical equivalent of the physical property of frequency.

2. Intonation or pitch acuity. The degree to which pitch is accurately produced in performance. Correct intonation means playing or singing notes exactly on pitch. Poor or inaccurate intonation means that the notes produced are above or below their proper pitches. Intonation is also defined as conformity with a tuning standard. In the present study pitch deviation will be calculated from the equi-tempered standard.

3. Cent. It is the one-hundreth part of an equal-tempered semitone, one twelve-hundreth of a perfect octave. Used to determine slight variations in pitch.

4. Pitch discrimination. The ability to detect subtle discrepancies in pitch from an established norm or criterion.

5. Pitch perception. The evaluation of pitch as it is registered in the ear and mind of the listener. The subjective appreciation of a musical sound in relation to a pitch standard.

6. Performed pitch accuracy. The actual performance of a pitch instrumentally or vocally adhering to an intonational standard. Accuracy of note execution after the mental discernment of pitch height.

7. Pitch deviation. Lack of conformity to an intonational standard. In this study pitch inconsistencies will be calculated in cents from equal temperament.

8. Pitch location. Specific place on the fingerboard of a string instrument where the fingers of a performer must stop the string to produce the pitch of a note.

9. Pitch division. Specific points where the string must be stopped or divided to attain definite pitches following the ratio of approximately 1/18 of the available vibrating string for a half tone, and 1/9 for a whole tone.

CHAPTER 2

RELATED LITERATURE

Experimental research investigating the processes of pitch perception and performed pitch accuracy has been carried out by scholars from a variety of disciplines including psychology, physics, psychoacoustics, applied music, and music education. Findings of these investigations have served to formulate new methodologies relevant to the teaching of performed intonation in instrumental music.

Research studies related to pitch perception and performed intonational acuity have addressed the aural, visual, and kinesthetic elements of musical perception. Some studies have explored one dimension to a greater degree than the others, however, the three contribute to the production of correct intonation. Due to this fact, somw studies will be reviewed from more than one perspective, according to how their results apply to the present investigation.

This chapter will review studies on the early development of musical discriminating ability, instructional approaches used in the teaching of musical skills, aural training and intonation acquisition, the use of modeling strategies in music teaching, visual perception and intonation accuracy with a review of computer programs and electronic equipment, and the kinesthetic factor as applied to string intonation.

Early Development of Musical Discrimination Ability

The early stages of musical training are optimal to impress upon a youngster’s mind the concept of performed pitch accuracy and the formation of a tonal memory needed to carry out intonation endeavors (Barrett, 1976). A brief overview of the development of pitch discrimination abilities from preschool children to adults will follow.

Research studies examining the development of pitch discrimination and the understanding and acquisition of other musical concepts by very young children have explored several musical behaviors. Webster and Schlentrich (1981) investigated the ability of 4- and 5-year-old children to discriminate pitch direction using one of three modes of response: verbal (spoken), gestural, and performance-based; and taking four variables into account (a) item range (narrow or wide intervals), (b) number of pitches in each item, (c) item presentation order, and (d) item direction - ascending vs. descending.

The researchers started from the premise that most young children are capable of perceiving changes in pitch, but their inability to communicate their understanding of concepts such as melodic direction, register, contour, and interval size may be due more to mode of response than to a lack of conceptual understanding. To overcome this situation three test formats were constructed to correspond with the three response modes, and designed them to be as equivalent as possible. In each format the child was (a) tested individually, (b) had only one chance to respond, and (c) had an either/or choice in responding. Choice or responses were: pointing up or down for the gestural mode, playing up or down for the performance-based mode, and saying “going up” or “going down” for the verbal mode. Subjects for the study (N=107) were from schools where music programs contained no formal training in pitch direction discrimination.

The results of the study indicated that the performance-based mode outranked the other modes as evidenced by the children who scored above chance buy not at the highest level. These findings reinforce the notion that non-verbal, performance-based response modes are the most natural way for young children without much training to react to pitch direction. In general, however, there was not statistical significance for group data due to the fact that a large number of children responded at or below chance regardless of mode. Therefore, caution must be exercised with the assumption that children can discriminate pitch direction if
the proper mode of response is used.

The ability to recognize chords (harmony) involves pitch discrimination skills in a somewhat more accentuated manner than if attempting a pitch matching endeavor. The complexity

of the task requires subjects to listen more discriminately to distinguish the differences in tonalities. Harmonic discrimination is one of the most difficult musical concepts for children to grasp, and it occurs later than the acquisition of other concepts such as timbre, loudness, tempo, duration. Conflicting conclusions regarding the harmonic abilities of young children is perhaps the result of

differences among the various measures of harmonic perception used in research: preference, verbalization, kinesthetic or visual representations. There is agreement, however, that harmonic development in preschoolers is to a great extent the result of acculturation, that is what children listen to on an everyday basis is what molds their mind and makes them

accept certain harmonies as correct or not correct.

Costa-Giomi (1987) sought to explore the ability to recognize chord changes of 4- and 5- year-old American and Argentine children. Subjects were asked to identify harmony

changes in two songs, one with harmonic movement between major tonic (I) and dominant seventh (V7), and the other with
a minor tonic and a subtonic (i-VII), first listening to the harmonic accompaniments only and then the harmony plus the melody. To control for order of presentation half of the children listened to the stimuli in a reverse order. The harmonic accompaniment consisted of block chords played on each beat of the songs on a synthesizer.

Results of the study indicated that 5-year-olds were able to identify harmonic changes when presented with the accompaniment alone, 4-year-olds could not do so; and that neither group could identify the chord changes when presented with a melody. Other important aspects of the results indicate that complexity and age are two important variables in young children’s harmonic perception; young children have difficulty isolating more than one musical concept when presented simultaneously; and that children tend to perceive harmonic changes better when presented initially with simpler stimuli that clearly reflects chord changes and then with the addition of the melodic element.

The present investigation will use the presentation of simple aural stimuli: intervals without rhythmic change, dynamic nuances, vibrato, or shifting, to ensure the accurate measurement of each subject’s pitch discriminating ability.

The Costa-Giomi study also seems to indicate that, based on age, physical and mental readiness are essential for the acquisition of some musical skills. Seventh grade string students will have received the thrust of beginning string instruction in the early grades of middle school and will be musically prepared, physically equipped, and mentally ready to receive and implement in their playing the different activities of the instructional methodologies involved in the experimental phase of the present research.

Forsythe and Kelly (1989) studied the effects of visual-spatial added cues on fourth-graders’ melodic discrimination.

The study was designed to test whether aural discrimination is significantly better when visual-spatial stimuli are paired with melodic phrases. A listening test was developed in which rhythmic and pitch relationships of short musical phrases were given visual-spatial-temporal realization by having a teacher move one hand, positioned palm down, from left to right across a chalkboard simultaneously with each melodic phrase. Subjects (N=244) were from three different elementary schools representing a variety of socioeconomic and family-community backgrounds. Subjects within each school were randomly assigned to one of three testing conditions:

(a) aural+visual to aural+visual (AV-AV); (b) aural+visual to aural only (AV-AO); and (c) aural only to aural only (AO-AO). Subjects in the AV-AV group received a videotaped presentation of both first and second performances of each melody.

Subjects in AV-AO group received the same videotape, but

each time the second playing was heard, the television picture was turned off so subjects heard the comparison melody but did not see the visual presentation. The switching of modes seems actually to hinder perception compared to the other modes of testing. Children in all schools were somewhat frustrated or confused by this mode of testing. Subjects in the AO-AO group listened only to the audio portion of the tape. A two-way ANOVA yielded significant differences for the school variable and the testing mode. The total mean score of subjects under the AV-AV condition was higher than the other two which revealed that the use of visual cues paired with melodies is an effective aid to aural discrimination among fourth-grade subjects.

The visual aspect in the training of pitch discriminating behaviors is of significant consequence. This research will implement activities belonging in the visual dimension in its field study. It is hoped that similar effect will be experienced by the experimental group receiving this instructional treatment.

Instructional Approaches

Music reading is a process that requires three perceptual levels: (a) auditory perception of musical sounds; (b) visual perception of music symbols; and (c) an integrative, internalized process through which individuals organize previous auditory and visual perceptions of a given stimuli so they can react to to these or similar stimuli as they occur in new learning situations (Petzold, 1960). This means that music reading is a performance of conversion of symbols into sounds (Klemish, 1970). Most music educators agree that music reading is a complex process, but there is no agreement as to which is the most effective instructional procedures needed to assist students in learning to read music.

Kendall (1988) investigated the effectiveness of two instructional approaches, the comprehensive and the modeling modes, in the development of aural and instrumental skills of fifth grade beginning instrumental students. The task required students to learn a non-familiar etude. The comprehensive mode included: student imitation of movement exercises to develop student kinesthetic responsiveness, student imitation of solmization syllables, association of syllables to melodic and rhythmic patterns, ear-to-hand coordination exercises, aural and visual association of melodic and rhythmic patterns (flash cards), melodic and rhythmic visual association, singing and playing of song material from the music textbooks (musical notation); and individual student performances of self-directed etudes.

The modeling mode contained all the above activities except those that involved any kind of musical notation. For the etude learning the teacher would demonstrate and students imitate. Students in this group used two audio cassette training programs as well. Both groups benefited from harmonic and rhythmic accompaniments that were added to all the aural, visual, and kinesthetic activities with the objective of helping students develop a sense of tonality and kinesthetic responsiveness. The subjects were 76 fifth-grade students in four intact beginning elementary school bands assigned to both treatment groups, two in each. The purpose of the study was to investigate whether introduction of music reading activities during beginning instrumental music instruction impedes students' development of aural musicianship and instrumental performance skills.

Data suggests that the comprehensive instruction, that included music reading, was more effective in assisting students in the development of melodic verbal association skills than was the modeling instruction. Music reading did not hinder the development of ear-to-hand coordination and instrumental performance skills, and when presented after melodic and rhythmic association, it provided students with the required skills for melodic and rhythmic sight-reading. The advantages of early acquisition of reading skills through aural and visual association activities is that students can gain the necessary aural skills that enable them to read melodic and rhythmic patterns that are based on previous aural experiences.

The relevance of this study to the present investigation is that it presents the use of several instructional techniques that will be incorporated in its experimental phase like teacher modeling-student imitation strategy, and the use of a visual component (musical notation and flash cards) in the acquisition of music reading skills. Both instructional approaches, modeling and comprehensive, were effective, however, the use of the visual element incorporated into the comprehensive method rendered it more effective in yielding greater results in intonational correctness.

Moore (1993) looked into the effects of age, gender, and melodic/harmonic patterns on pitch-matching skills of talented 8- to 11-year-old children. The purpose of the study was to determine: (a) how accurately children could sing tones from melodies and chords they heard, (b) which tones from chords would be easiest to reproduce vocally, and (c) what types of errors children would make in searching to match designated pitches in chords. Subjects were 128 children, ages 8 to 11, drawn from 56 schools, and selected by their music instructors as the outstanding singers in their schools. Subjects were auditioned for a community children’s choir and were tested individually for pitch-matching skills. The 10-minute pitch-matching test consisted of a series of 16 items that were organized in a series of 4 melodic and 12 harmonic patterns. These included 4 upper, 4 lower pitch-matching diads (two-tone chords), and 4 middle pitch-matching triads (three-tonechords).

All items were written within the singing ranges of all subjects which extended well beyond the limits of the test items. Two professional music educators were the judges for the study. The findings of the study revealed that all harmonic pitch-matching tasks were not of equal difficulty for talented children. The upper notes are easier to find. The lower note of a two tone interval was next in difficulty. The most difficult one was the task of matching the middle

pitch of triads. Findings indicated that part singing in sixths may be easier than in thirds and that singing the pitch of a major or minor second seemed difficult but not as challenging as matching the middle tone of a triad.

An interesting finding was that children more often err on the flat side following adult models and are more often sharp following child models. This leads to the belief that when presenting a model performance it should be in the same timbre as the medium in which the young player is going to perform, this seems to be conducive to a more accurate reproduction of the pitch task.

The applicability of Moore's study to this investigation is twofold: (a) the use of certain intervals as the most appropriate to reproduce them in tune are sixths and thirds, and (b) the significance of using the right type of models, children voices were imitated more accurately by other children than adult voices. Similarly, in the modeling portion of the aural training of this study the presentation of pitch stimuli (notes, intervals, and phrases) by the instructor will be done on a violin or a viola, instruments that subjects will use during the instructional period and in the recording of the pre- and posttest performance tasks.

Carmody (1989) studied the effects of performance in chamber music ensembles on junior high school string players' intonation and attitudes toward music. For purposes of the investigation the researcher defined chamber music ensemble as one having three to eight members, one student per part, and no conductor, while the regular instrumental classes were

designated as large ensembles. One group, composed of 26 string players, participated in large ensembles and chamber music groups. The other group of 28 students was involved in large ensemble experiences only. After 14 weeks of instruction, students involved with chamber music were judged to be significantly more in tune than those of students who were in large ensembles only. Additionally, the attitudes of chamber music string players toward music were significantly more positive than those of non-chamber music students.

Modeling

Modeling in the music instructional setting is the presentation of an exemplary performance that serves as a model for student imitation and the subsequent learning of a musical concept or behavior. Madsen, Greer, and Madsen

(1975) advance the notion that modeling in music performance is the presentation of a live or recorded stimulus that may be imitated or reproduced later by an observer, generally the student, and has the purpose of teaching specific skills or concepts, including intonation. According to Sang (1987) there are two types of modeling: (a) vicarious modeling methods that comprise tape recorded material or lessons on video, and (b) direct interaction modeling, which involves the presentation of a live model in the classroom, most of time by the teacher, followed by student imitation of the modeled behavior. Vicarious modeling is primarily used for home practice and for autodidactic (self-instructional) purposes. Live modeling, on the other hand, is a tool used during the development of a lesson in a group or private setting.

Researchers utilizing vicarious types of models (Bergonzi, 1991; Hodges, 1974; Puopolo, 1970; Zurcher, 1972) have encountered the problem of the willingness of the pupil to take the time to listen to the recorded material and effectively imitate an specific musical concept. Hodges

(1974) states that "If the students had been more actively involved in listening to these tapes and in making comparisons between their trials and the model performances, the results of this experiment might have been different" p. 102. In contrast, live modeling even though not free from distractors, i.e. student attentiveness, mental readiness, willingness to engage in the procedures, is a more direct and interactive type of activity that engages the students's attention and interest probably with far better results in the acquisition of musical concepts and behaviors.

Sang (1987) also asserts that interactive modeling can produce three types of effects: a) the acquisition of a new behavior, b) the strengthening or blocking of previously learned behaviors, and (c) the generalization or application of existing behavior patterns to new situations. In the teaching of pitch discrimination these three outcomes are possible and desirable. The presentation of aural stimuli, however, is affected by its temporal nature, condition that requires multiple presentations of the same stimuli for the effective formation of a musical concept. Delzell (1983) asserts that the learner forms a more accurate and complete concept after the salient properties of the concept are delineated as a result of multiple encounters with a model.

The modeling-imitation cycle is the presentation of a model by the instructor with the subsequent replication of the same material by the student. It is most often used with successive or repetitive presentations of specific material with the purpose of teaching-learning and reinforcement. Rosenthal (1984) investigated the relative effectiveness of four modeling conditions on advanced instrumentalists' musical performances. The four experimental conditions were designed to examine the effect of aural and verbal models on musicians' ability to accurately perform a musical selection.

The material selected was an etude deemed relatively obscure and within the range of all woodwind and brass instruments once it was transcribed. A recording of the etude was made by a professional violinist so no instrument was favored, and edited until it was accepted as a faithful representation of all the notes, rhythms, tempi, dynamic changes and other musical markings.

Subjects for the study were 44 graduate students majoring on either a woodwind or brass instrument, and were randomly assigned to one of the four treatments conditions: (a) guided model, composed of a combined verbal and aural example of the musical selection, (b) model only, with the presentation of just an aural model, (c) guide only, with a verbal explanation without any performance, and (d) practice only. The results of the investigation established that all modeling conditions affected subjects' performance.

The guided model did not enhance subjects' ability to perform the etude accurately despite the fact that the guide was designed to help students focus their attention on the most critical and complex aspects of the music. In fact, the guide may have hindered subjects' musical performance. Verbal instruction alone may be no more effective than independent practice in helping subjects to perform accurately. Direct modeling, without any added explanations, may be the most effective way of helping a student perform accurately.

Francisco (1994) investigated the relative effect of verbal communication, visual communication, and modeling on the performance improvement of high school bands, using the aspects of tone quality, intonation, rhythm, technique, interpretation, and balance as variables. He observed on a rehearsal setting twenty five conductors with teaching experience ranging from elementary to university level. Videotapes of the rehearsal included the performance without stops of the piece that was to be rehearsed, and then the normal development of the rehearsal, this was done in order to have a reference point for the evaluation of any improvement.

The researcher edited the videotapes selecting specific excerpts that would exemplify the different conductor communication behaviors. The selected sections were then analyzed by the researcher to document the number of occurrences of those behaviors that had the purpose of initiating a change in the rehearsal. All excerpts were transferred to another video tape that was evaluated and scored by a panel of experts. The inter-judge index of agreement according to type of communication and purpose of communication was unacceptably low ($r=.63$) which required a series of multiple regression analyses to test for the effects of type of communication and purpose on performance improvement scores, and interaction of variables.

The findings revealed that the type of communication and purpose had a significant effect upon ensemble improvement scores. The combination of the verbal/modeling/visual elements of communication was significantly more likely to improve ensemble performance than verbal/visual, or visual. Visual communication, when used alone, was significantly less likely to improve ensemble performance than verbal/modeling/visual, verbal/modeling, or verbal communication. Francisco asserts that "it appears that modeling, at least when used in combination with verbal/visual, may add to the effect of musical problem solving" (p. 185). The combination of the three communication types probably better maintains the student attention than using one, or two methods, keeping more ensemble members on task and enhancing their chances for understanding the concepts.

In a related study, Tomlison (1999) investigated the effects of recorded models on the performance achievement of beginning brass instrumentalists. Subjects (n=60) were selected from two middle school beginning band programs and were randomly assigned to the experimental and control groups.

There was a pretest to determine the performance level of each participant followed by a 10-minute individual lesson. During this session the researcher requested subjects to finger or slide through a twelve-bar etude that was explained orally with verbal reminders, explanations and anticipated problem spots, and instructions on performance. The lesson was outlined and scripted a priori so that all subjects would receive the same instruction. The control group participants were asked to quietly finger or slide through the etude, while students in the experimental group were asked to listen to a recorded model of the piece and to finger or slide as they listened. At the end of the lesson subjects were asked to perform the etude which was recorded for later analysis.

The pretest score was used as a covariate and the posttest score was used as the data for the statistical analysis that included ANCOVA procedures to determine the efficacy of the treatment on four musical elements: interpretation/musical effect, tone quality/intonation, technique, and rhythm/tempo. Results of the study indicated that only on the rhythm/tempo category the immediate feedback of a recorded model achieved significance at the $<.01$ level. According to the author a possible explanation for this result is that the study lacked "guided" instruction which leads to conclude that guidance or instruction is important during the modeling process for this age group. However, it is more likely that other factors affected the outcome of the study: subjects had to pay attention to too many aspects of the performance, the duration of the instructional session was inadequate to expect any kind of instruction to take place or to be retained, and the fact that subjects were exposed to the model only once. The inherent weaknesses of this investigation do not allow for inferences to be drawn or generalizations to be made.

Sang (1987) sought to answer the following questions: (a) what relationship exists between an instrumental music teacher's modeling skills, and pupil performance behaviors, (b) since modeling is not a single behavior, but a composite of several skills, what are the contributions of some of these skills to the variance among pupil performance behaviors, and (c) what relationship exists, if any, between a teacher's overall modeling ability and his/her frequency of modeling in the classroom.

Nineteen teachers of first-year instrumental music classes were randomly selected to participate in the study. Sang chose first-year instrumental classes to control for the influence of instrumental instruction from other teachers or other schools. Teachers selected ten to twelve of their beginning students to participate as subjects in the study (n=204). Students who had other instrumental background (e.g., piano), or private instruction in addition to regular school instruction, were ineligible to participate to insure single-teacher influence.

Each teacher was given a battery of tasks that comprised modeling skills (a) performing exercises on the instrument of his students, (b) playing self-chosen selections on the teacher's major instrument, (c) visual analysis of musically-related performance skills based on criteria established by the Visual Diagnostic Skills Program for both major and secondary instruments, and (d) the Test of Ear-to-Hand Coordination. Tasks 1, 2, and 4 were recorded and evaluated by a panel of professional musicians, while task 3 was evaluated by the researcher.

Additional control factors were the weighting of scores by a proportional scale related to contact hours (teaching hours), and percent of class time teacher spent using modeling techniques verified by random visitation. Data were analyzed by multiple regression procedures that yielded a regression coefficient of R^2 =.89 which was found to be statistical significant at the <.0001 level.

This indicates that most of the variance in pupil performance behaviors can be accounted by the teacher modeling skills as defined in the study. Further analysis of the data indicated that all but the musically-related skills contributed significantly to the variance of the dependent variable. According to Sang (1987) "a teacher's ability to model and the degree of use of demonstrations in the instrumental class has a bearing upon pupil performance levels" (p. 158). In other words teachers who have stronger modeling skills and apply those skills in teaching are more likely to produce students who perform better than teachers who do not.

The purpose of a related investigation by Quindag (1992) was to determine if modeling conditions had a significant effect on the performance achievement of beginning string students. Her study had three levels of experimentation: guided aural modeling, guided aural-visual modeling, and practice with no modeling conditions. Subjects for the study were twenty-three fourth-, fifth-, and sixth-grade beginning string students. Aural and aural-visual modeling tapes were produced and tested during a pilot study. Also a two-part Likert scale adjudication form was designed and tested to be used by the adjudicators of the main study.

The treatment phase lasted 10 weeks with subjects being randomly assigned to one of the three experimental groups. The setting was a heterogeneous string class that met three times weekly for thirty minutes. Subjects were instructed on the practice procedure prior to receiving the practice tapes.

The researcher monitored the number of, and the length of the at-home practice sessions via a practice record sheet that parents had to sign. At the end of the instructional period a posttest was administered to the subjects and recorded. Expert raters evaluated and scored the tapes. The scores were analyzed with ANOVA procedures and the results indicated that the three practice conditions did not significantly contribute to the performance improvement of the subjects.

The researcher provided possible explanations for the non-significant results of the study: the sample size (n=23) was not large enough, the length of the treatment was not sufficient, the subjects were of three different grades with a wide range of musical backgrounds, and the subjects' practice habits were difficult or impossible to control which accounted for the possibility of inconsistency of treatment.

As explained in the previous chapter vicarious forms of modeling have the inherent negative factor of the subjects' whillingness to practice and to follow instructions.

The Kinesthetic Factor

The kinesthetic element in instrumental music comprise all the movements involved in the playing of an instrument. In string playing these actions include the fine motor skills a player needs to execute the movements involved in producing a pitch. Any sound produced by an instrumentalist is the result of a series of physical motions or actions from the moment the pitch of a note is conceived mentally to the instant when that pitch becomes audible. For that action to be precise and useful in the attainment and adjustment of pitch, it must be guided by correct principles of playing technique. Studies examining kinesthetic action of string players are limited, Cowden (1969), Slayman (1956), Jacobs (1969), Rolland (1974).

Cowden (1969) made a comparative study of the intonational performance of beginning violinists implementing a first- and third-position approach. He used two groups of fourth and fifth graders (n=37) that received instruction for 16 weeks in the following fashion: one group was taught using first position for 11 weeks, then switched to third position for the rest of five weeks. A second group used third position for 11 weeks and then first position for five weeks.

After the 16 weeks of instruction, all students performed three pieces: one in first position, one in third position, and one that required shifting between first and third positions. A panel of five judges composed of experienced string instructors assigned ratings to all the performances. The analyses of these ratings revealed that there was no significant difference in intonation between the two groups for any of the three performed pieces.

Slayman (1956) worked with beginning string students and

promoted a change in the holding of the violin from the customary hold to a banjo-like instrument hold. He surmised that since banjo or guitar players were able to see their fingers as they place them on their instruments, also violin players would benefit from being able to see their hand and fingers to shape them with the proper curvature and separation if they would use this type of instrument hold still keeping as much as possible the proper position of their arm in relation to the instrument. The results of the study revealed that guitar-type hold of the instrument fostered fast skill development of finger placement when used with classes below the sixth grade level and suggested that it be utilized to teach new fingering patterns to young violin and viola students.

Jacobs (1969) conducted an investigation that examined another kinesthetic aspect of violin playing. She developed her investigation from the premise that movements are the means of musical expression on any musical instrument. She maintained that even the most delicate nuances of a performance can only be brought to realization by means of movements. Therefore, it was important to study the application of movements in the performance of an instrument to promote those that give better results and avoid those which might cause harm.

Subjects were twenty string students whose ages ranged from 11.6 to 13.2 years divided in two groups: (1) students with trained musical hearing, and (2) students with untrained musical hearing. Subjects trained during twenty sessions of

half an hour each over a period of twenty days. Sessions were tape recorded. The observed errors were recorded and divided into categories to be analyzed and used for comparison within groups and between groups.

The results of the study brought to light the fact that subjects with musical training were very disturbed when the notes they performed were out of tune, but they didn't make use of the proper tactile or kinesthetic action to correct those errors, while the untrained subjects when they heard notes out of tune they immediately relied on the tactile or kinesthetic actions they knew and were able to correct pitches successfully. More errors were made by the trained musicians than the untrained, which indicates that knowing the proper use of kinesthetic movements is a great help in making corrections to pitch. This seems to be a contradictory finding since the trained musicians made the most errors. Their sense of pitch made them aware of the magnitude of their out-of-tuneness but they lacked the knowledge of the proper kinesthetic action needed to make the corresponding adjustments; while the other students simply relied on the correct shape of their hands and finger patterns to correct the mistakes without paying that much attention to the actual pitches or sound.

Rolland (1974) studied the basic movement patterns that are involved in string playing. He developed a series of sequential movement studies that were designed to develop specific neurological responses. The core of his ideas and principles are contained in his book The Teaching of Action in String Playing.

The main tenet in his teaching was the hypothesis that movement training, designed to free the student from excessive tensions, will result in faster learning and better performance. His methodology was aimed mainly at violin and viola players, however, he maintained that the same principles could be applicable (with some minor adjustments) to cello and double bass players. Results of public school field tests indicate that Rolland’s approach to movement training promotes rapid kinesthetic skill development in beginning string students.

Aural Discrimination and Intonation Acquisition

Music, as an aural experience, necessarily involves the sense of hearing. This faculty enables a person to perceive musical stimuli, and guides the musician in the execution of pitch adjustments needed to make the intonation of a performance correct and enjoyable.

Bergonzi (1991) investigated the effect of harmonic context on the intonation improvement of 6th grade beginner string students, and the effects of finger placement markers on intonation performance, left-hand technique, and overall musical performance skills. The harmonic accompaniment consisted of tonic, subdominant, and dominant harmonies in D major played on a synthesized piano timbre. The harmonic background duplicated the melodic rhythm of the song(s) used during class instruction. Additionally students of the classes receiving the harmony treatment played other musical materials (i.e. scales in rounds) that also provided an aural reference for intonation accuracy.

Students had also at their disposal a researcher-developed audio cassette recording (vicarious models) with which the investigator aimed to maximize and standardize the potential effect of the harmonic treatment. Each selection had (1) a melodic pattern to be used for a presentation-student imitation routine, (2) a complete performance on viola for silent fingering or bowing practice; and (3) an accompaniment minus the melody. Tapes for students in the harmony groups had both harmony and rhythmic accompaniments, while the one for students in the non-harmony groups had only rhythmic backgrounds. Students were allowed to take home a

free copy of the tape for individual practice.

Tape recordings of individual students were adjudicated by a panel of experienced music educators whose inter judge reliability was established at .89. The findings in regards to the use of harmonic accompaniment was that it aids intonation accuracy, and also assists in the development of string students' overall musical performance ability. This contrasts with the findings of previous research (English, 1985) involving the use of piano accompaniment in string classes. Perhaps the difference in results rests on the fact that Bergonzi systematized and amplified the use of harmonic accompaniment through the use of practice cassette-recordings which provided additional opportunity for melodic pattern drill; and that the intonation measurement was done of individual students and not of entire classes.

Sogin (1987) conducted an investigation with the purpose of observing string instrumentalists' intonational performances within the duration of selected pitches. He also investigated the effect of directionality of performed pitch sets, the effect of vibrato against no-vibrato, and differences in intonational performance within instrument groups. Subjects (N=48) were selected from the college and professional string instrumentalists: 12 violinists, 12 violists, 12 cellists, and 12 double bassists.

The performance task for the investigation was an ascending and descending four-note scalar pattern beginning on E-flat and ending on A-sharp. The researcher reasoned that in the past, research had focused on major scales, minor scales, whole-tone scale patterns, melodic and harmonic intervals, and that using a pitch set containing a relatively infrequent scalar pattern (Eb, F, G#, A#) might contribute new information about intonation performance. Four performance order groups were formed with three subjects of each instrument being randomly assigned to these blocks. All subjects performed the same four pitches with vibrato and direction conditions arranged in counterbalanced order, with a fifth pitch added to control for any performance strategies in relation to the first tone. The added pitch was C before playing the fourpitches ascendingly and C# before playing the same pitches descendingly. Subjects had a 2-minute warm-up time prior to recording the research material.

A controlled tuning was done using a prerecorded oboe pitch (A=440Hz) and monitored with a Conn Chromatic Stroboscope. Each group of 12 randomly blocked subjects recorded ascending and descending pitch sets both with and without vibrato. The duration of each pitch was about 4 seconds. A video camera recorded the digital output of the frequency counter to ensure reliability of observations, and the frequencies were converted to cent deviations from equal temperament standards.

Data were analyzed with ANOVA to determine the interaction regarding pitch location 1 (entry point) and pitch location 2 (ending point), individual tones, directionality of pitch sets, and stringed instrument types. All statistical analyses made in the study were done at the .01 level of significance. The results of the investigation revealed that: (a) during the duration of the pitches string instrumentalists tended to perform sharper at the end of the pitch than at the beginning, (b) scalar material was performed sharp regardless of melodic direction, pitch sets were sharper when performed descendingly than ascendingly, (c) the tendency toward sharpness was present in the vibrato and the non-vibrato conditions, and (d) instrument groups did not differ from each other significantly regarding direction of cent deviation.

The relevance of these findings to the present study is that the music task involving a descending scalar passage was deemed to have the least pitch deviation. If this condition is an indicator of correct intonation the choice of similar scalar direction in a music task should prove to be helpful in giving some stability to the intonational acuity of young string players when performing descending scalar passages.

Intonation Perception and Performance

Perceived intonation and performed intonation are not the same sensory experience. The literature points out that trained string musicians tend to err on the side of sharpness. This means that string musicians detect more readily flat deviation, whether that deviation is present or not, and as a consequence their adjustments are generally in the sharp direction (Madsen, 1962, 1966, 1974; Madsen, Edmonson, & Madsen, 1969; Mason, 1960; Salzberg, 1980). Explanations advanced by investigators of this phenomena are that since string instrumentalists have at their disposal a continuum of pitch, when correcting the perceived flat inaccuracy of pitch they overcompensate in the sharp direction, and that in many instances they enact a correction unnecessarily to pitches that are in tune but are perceived not to be so, with the result of having a constant sharp performance which resembles or hints the use of the Pythagorean system of intonation.

Geringer (1977) investigated the relationship between the performance of intonation and the perception of intonation as they apply to ascending scalar patterns. The ninety-six undergraduate and graduate students that served as subjects were selected from the following groups of applied
music study: string instrumentalists, wind instrumentalists, keyboard instrumentalists, and vocalists. String and wind instrumentalists performed on their instruments, while keyboardists and singers used their voices.

The performance material was an ascending scalar pattern with a minor seventh, which corresponds to the Mixolidian mode, and was built on the fifth note of the C major scale (sol, la, ti, do, re, mi, fa, sol). The scalar passage was performed with and without piano accompaniment. All subjects were randomly assigned to four experimental conditions: (a) performance of unaccompanied ascending scale (sol-sol), (b) performance of accompanied ascending scale, (c) perceptual retuning of own unaccompanied scale performance, and (d) perceptual retuning of own accompanied scale performance.

Tape recordings of performances were done individually preceded by a three-minute warm-up. Between performance trials subjects listened to 15-second segments of orchestral music intended to block tonal memory from influencing any pitch acuity on successive trials. Half of the subjects (N=48) performed the material a second time while the other half (N=48) engaged in the perception task by listening to their own scale recording in order to make any adjustments, by means of a variable-speed tape recorder, that in their judgment were needed to make the scale more in tune. Scores expressed as cents flat or sharp relative to equal temperament were the raw data for statistical analysis.

Results indicated that a tendency toward sharp intonation was consistent throughout the study. The comparison of intonational performance with intonational perception was tested by means of an ANOVA and the Newman-Keuls multiple-comparison tests. The absolute and the directional cent deviation from equal temperament analysis revealed significant differences between perception and

performance. Analyses indicated also that accompanied scales were performed and perceived with significantly less absolute deviation and a tendency to be less sharp than unaccompanied scales. The perceptual intonation of the unaccompanied scale
was significantly less accurate than the perceptual intonation of accompanied scales and the intonational performance of both.

In a related study, Geringer and Witt (1985) investigated the tuning performance and tuning perception of string instrumentalists, focusing on the relationship between the perception of tuning stimuli and performed tuning accuracy. Subjects were 60 high school students and 60 college students-professionals who were randomly assigned to three stimulus conditions. Stimuli were three tape-recorded oboe tuning tones to which the subjects were asked to tune their instruments. The levels of the oboe tuning tones were 440 Hz., 465 Hz (sharp deviation), and 425 Hz, (flat deviation). Each subject recorded the tuning procedure after which was asked “How would you judge the intonation of the A on this tape? Response codings were: (a) sharp/a little sharp, (b) in tune, or (c) a little flat/ flat.

A two-way ANOVA revealed a significant difference between cent deviations relative to the three pitch stimuli. A Chi-square analysis of responses concerning the perceived intonation of the stimulus pitch indicated significant differences for high school students, college students-professionals, and total responses. The results indicate that subjects gave significantly more “flat” than “sharp” or “in tune” verbal responses.

This is consistent with other research findings that reveal string instrumentalists have the tendency to perceive pitch inconsistencies more in the direction of flatness than sharpness. The tuning performances were in agreement with the verbally expressed perceptions for 62% of the college/professional subjects, and 43% for the high school students. Even though there was a difference between the two groups of subjects, these percentages indicate a limited degree of association between the performance and perception of the pitches involved.

Visual Perception and Intonation Accuracy

The visual aspect of intonation in string playing involves the player ability of “seeing” where the pitch points are on the string before the production of a pitch by means of devices that are attached to the fingerboard. i.e. dots, tapes, stars, etc. During or after a performance has taken place a player can visually see the accuracy of his/her intonation by means of electronic devices that can read and measure the frequencies produced.

Finger Placement Markers

In string teaching one of the devices most commonly used to guide students in learning how to place their fingers on the fingerboard is that of finger placement markers (FPMs). These are thin tapes placed across the fingerboard of a string instrument at distances following the ratio of 1/18 of the vibrating string for a half tone and 1/9 for a whole tone.

Their use in contemporary string education has been advocated by proponents of the Suzuki methodology as the primary teaching technique to develop intonation skills. Advancing an explanation for their use Behrend (1985) states that "Suzuki intends the fingerboard tapes to be used for two purposes: to establish a good left hand position, and to help the parent..." in guiding the child's fingers to be placed correctly on the fingerboard. They are also for relating pitches to finger placement, even though, "the only dependable guide for finger placement, and therefore intonation, is the ear" (Berhend, 1985, p. 13).

Opponents of the use of these devices warn that it is not possible to shape the hand in any one position that will automatically result in good intonation. "Correct intonation is a habit acquired only through attentive practicing and an inherently good ear" (Rolland, 1959, p. 24). Gordon (1988) regards them as a "substitute for audiation skill", and proposes that individuals that have not developed tonal audiation and singing skills are not ready for instrumental instruction. This debate has produced some controversy among string educators that consider the use of FPMs a matter of personal preference; FPMs are a tool that when properly used can produce positive and lasting results.

Smith (1985) investigated the visual and kinesthetic aspects of intonation in string instrumentalists. Her study was primarily concerned with assessing the effect of finger placement markers (FPMs) on the development of intonation accuracy in beginning string students. Subjects (N=18) were university music students in string methods classes who were randomly assigned to three treatment groups. Group A did not use any FPMs during the sixteen-week experimental period; group B subjects used first and third finger placement markers in first position throughout the duration of the experiment; and group C utilized FPMs for only the first eight weeks of the experimental period. All subjects were music majors without any previous string instrument studies, each playing the violin during the entire experimental process.

The three groups met twice a week for thirty minutes and were taught by the investigator. All groups covered the same instructional material. Subjects were tape-recorded an the end of eight weeks and at the conclusion of the experiment. A panel of five string experts listened and rated each subject's intonation on a five-point rating scale ranging from poor too excellent. Before the start of the experiment subjects were administered the pitch subtest of the Seashore Measures of Musical Talent so the scores could serve as an indicator of each subject's musical ability. Also the Scholastic Aptitude Test scores were obtained and utilized as indicators of the subject's intellectual ability.

The inter-judge reliability was .72 at the end of eight weeks, and .76 at the end of the sixteen-week period. Statistical analysis using ANOVA and ANCOVA with Repeated Measures tested the main effects due to treatment, and the interaction of covariate effects. Results revealed non-significant F values for both main effects – finger placement markers and the two teaching approaches, as well as the interaction between the FPMs and the teaching approaches. The FPMs did not have a significant effect on the development of intonation accuracy. The subjects of group B obtained

lower scores in the second test which indicated that the removal of the FPMs had an adverse effect on the development of intonation. One interesting finding, however, was that intellectual ability seemed to have had a greater effect on the development of intonation accuracy than did the other variables.

Designed as a follow up study Smith (1987) replicated her previous investigation drawing from a different sample population. The purpose of this study was to determine what effect kinesthetic aids (finger placement markers) had on the development of intonation accuracy in beginning string students. The sample population were eighty-three fourth- and fifth-grade students in twelve intact beginning string classes. Subjects were randomly assigned to three treatment groups: group A used FPMs for the entire thirty-two weeks of the school year; group B had FPMs for only the first sixteen weeks of the project; and group C did not use any FPMs throughout the duration of the experiment.

Each of the twelve groups met twice a week for fortyfive minutes with all subjects playing the violin for the entire year. Out of the eight teachers that participated in the study only two were string specialists while the other six were wind players that had taken one-semester string skills course at the undergraduate level. Teachers were randomly assigned to one of the three treatment groups.

During the treatment period subjects were recorded individually four times at different intervals: at the end of eight weeks, sixteen weeks, twenty-four weeks; and thirty-two

weeks. A panel of three public school string teachers listened and rated the tapes for intonation accuracy on a scale ranging from 5 (poor) to 1 (excellent). The assumption was that (1) students that used FPMs would make the greatest gains in intonational accuracy, (2) the removal of these devices would not have an adverse effect of intonation, and (3) differences in musical ability, academic achievement, and teacher would not have any effect on the development on intonation accuracy.

The inter-judge reliability correlation ranged from .81

to .90 for the four rating periods. The findings of the study revealed that the use of FPMs (1) did not significantly aid the development of intonation accuracy, (2) intonation was adversely affected by the removal of these kinesthetic aids, and (3) musical ability and academic achievement did not play a significant part in achieving accurate intonation. One important finding was that teacher effect perhaps accounted for the low effectiveness of the treatments.

The nonstring teachers were not technically prepared to effectively implement the methodologies of the treatments teaching elementary level string classes, thus, affecting negatively the results of the experiment. In the present investigation care has been exercised to secure subjects in schools where the instructors are string specialists with several years or successful teaching experience.

In a related study, Bergonzi (1991) investigated the effects of finger placement markers and harmonic context on the left-hand technique, intonation performance skills, and overall musical performance skills of sixth-grade beginning string students. His research was directly concerned with the question of how the tactile/visual reference and an aural reference influence the development of intonation skills in string performance.

The use of FPMs investigated by Smith (1986, 1987), yielded poor or negative results; in both studies these devices did not aid in the attainment of intonation. Smith's recommendation was that to teach string instrument intonational proficiency it is better to limit the use of these devices or not to use them at all. Bergonzi makes the point that the pedagogical value of the use of FPMs can be traced back to the late 1700s when Correte, Geminiani, and Leopold Mozart used them as acceptable aids to help young players in learning how to play a string instrument (Riley, 1987). It is not clear, however, if these devices were intended to help with the technical development of the young player or if they were supposed to help with the tonal development and consequent intonational improvement of the student.

The focus of the investigation was the study of FPMs and harmonic context (accompaniment) on the development of intonation and overall musical performance skills of elementary-school beginning string players. Subjects were 76 sixth-grade beginning string students taught in a heterogeneous class setting. The teaching of intonation was approached with an aural emphasis, including vocal and instrumental imitation of melodic patterns and the singing of musical materials using tonic-solfa syllables. The FPMs were provided for the first (major second) and third fingers (perfect fourth) only. Students selected to use FPMs were randomly chosen.

With regard to intonation the results of a two-way ANCOVA indicated that students with FPMs played significantly more in tune than students that did not have them, and that the effect of the FPMs was independent of harmonic accompaniment. The findings concerning harmonic accompaniment was that it not only aids intonation accuracy, but also it assists in the development of string students' overall musical performance ability.

The Bergonzi (1991) study explored variables belonging in the visual and the aural components of intonational training. Finger placement markers offer a visual guide to the young student indicating where to place the left hand fingers. The application of this aid was enhanced by the harmonic accompaniment that presented a chordal context or background by which the students would correlate the pitches they were producing. In a similar manner, but without the use

FPMs, the visual aid used in the present study will provide a visual guide to the students as to where to place their fingers.

The results of the Bergonzi study revealed that the use FPMs aids in the improvement of pitch accuracy of sixth grade students as judged by the panel of string specialists. Although this finding is contrary to the results of previous research (Smith, 1985, 1987), the efficacy of this treatment is well documented and can be applicable to the class instructional setting .

Intonation and Computer Programs

Computer assisted instruction (CAI) has been explored as

a means of helping young students in improving their instrumental intonation acuity. Computer graphics give the performer a visual means of "seeing" the accuracy of a performance thus providing a way of correcting inaccurate pitches with the goal of developing pitch discriminating ability.

Eisele (1985) developed "The Intonation Skill Development Program" (ISDP), a computer-assisted instructional program designed to improve students' pitch discrimination. The purpose of his study was to determine whether the ISDP helped students improve their intonation as they perform on the violin or the viola. Subjects were 50 sixth, seventh, and eighth grade violin and viola students enrolled in 2 junior high schools in a public school string program.

The program was designed for the students to review note names and finger placements for very simple chromatic alterations. These included the two positions of the second finger, "low" and "high", on both the D and the A strings. The pitch-matching objectives were derived from the research of Porter (1977) and Heller (1969) and consisted of: (1) given two pitches, the student had to determine and select the lowest sounding pitch. Pitches deviated from 25 to 200 cents. Student response was via the microcomputer with a time limit of 10 seconds, (2) given two bar graphs and corresponding pitches, one a stationary bar graph and pitch, the second a movable bar graph and pitch, the student had to match the movable bar graph and pitch to the stationary set by moving the Apple paddle dial, and (3) given two pitch sets, one stationary, one movable, the student had to match the movable pitch to the stationary pitch by moving the Apple paddle dial. In the last two conditions after mastery of 200-cent deviation this limit was lowered progressively to 100-cent, 50-cent, and 25-cent.

Before and after the treatment the subjects took the Colwell Music Achievement Test, Pitch Test 1 and performed an etude specially written by the researcher to demonstrate mastery of the skills required by the ISDP. Students, 3 at a time, worked independently on the training program during string lessons and were able to complete the program three times during a three-week period. Students in the treatment group made significant gains on the Colwell test. Results of the study revealed the ISDP was effective in training students to make intonational comparisons and matching of two different pitches.

Meyer (1993) developed a computer assisted instructional program starting from the premise that a violinist can achieve correct intonation by developing a better sense of pitch discrimination, and that pitch discrimination is more effectively attained when aural perception is reinforced with visual perception. This program has the unique feature of extracting the fundamental frequencies from musical notes fast enough to give the performer an immediate feedback in real time. The instant graphic display of pitch permits the eye-ear coordination to assist in the development of a heightened level of pitch discrimination.

The two hardware components were a microcomputer and the Pitch Analyzer capable of extracting the pitches' fundamental frequencies. The software consisted of three independent computer programs: (1) tuning the open strings, (2) playing scales, and (3) playing musical passages. The student could use one or more of the programs at the same time. Also in each program the student was able to select two different tuning systems: Pythagorean or equal temperament, error tolerance level, metronome setting, and "practice" vs. "test" session. The practice session ran in real time, with an instant display and immediate feedback for the students to see how far off they were from the precise pitch, and correct it before proceeding to the next note. The test session did not allow corrections but yielded a score after the completion of the scale or passage, monitoring in this manner the student's progress and hopefully presenting an incentive to improve.

Electronic Equipment and The Representation of Pitch

Electronic equipment (i.e. pitch master, graphs, strobo tuners) has provided a reliable means for pitches to be visually detectable and analyzed for purposes of correction and improvement. Brick (1984) tested the viability of Gordon's aural/oral theory that stipulates a transfer relationship exists between aural pitch perception and performance pitch accuracy. He developed an aural/oral pitch perception program to be used with the TAP Pitch Master and tested its effectiveness with junior high school trombonists.

Subjects in the experimental group of his study listened to pitch patterns, orally reproduced what they heard, and then performed the patterns on their instruments. Results revealed significant gains on both aural pitch discrimination and performance pitch accuracy. It was surmised that the same instructional approach would produce similar effects on young string instrumentalists.

Smith and Brick (1991) examined what effect an aural/oral pitch discrimination program patterned after the Edwin Gordon's aural/oral transfer theory would have on beginning violinists' aural pitch discrimination and performance pitch accuracy. Subjects were twenty-eight fourth and fifth-grade beginning violin students from two intact string classes. They were randomly assigned to a control group that met three times a week, and an experimental group which spent two thirty-minute weekly training sessions with the Pitch Master. Both groups used the same method book and had the same teacher, the researcher.

The Pitch Master Exercises were researcher-designed tapes consisting of 64 musical exercises in the keys of D, G,

F, and C major with a sequence and degree of difficulty paralleling that of the method book. The instructional sequence was the following: (1) subjects listened to the exercise once, (2) there was a 10 second pause, (3) subjects listened to the exercise a second time and sung into the

Pitch Master, if they were successful in reaching the criterion score they turned off the tape and play the exercise on their violin, (4) the subjects listened to the exercise once more and proceeded to the next one.

The study had a pretest-posttest design. Subjects recorded a sixteen-measure melody in the key of D major at the beginning and at the end of the experiment. A panel of three public school string teachers listened to these tapes and rated them for performance pitch accuracy. Inter judge reliability correlations calculated by a Pearson Product Moment Correlation were moderately high: .81, .85, and .87. ANOVA revealed gains in both the aural pitch discrimination and performance pitch discrimination in favor of the experimental group, however, these gains were quite small (+.05 points). The low success of the program was attributed to several possible causes: (1) small sample size (n=28), (2) low inter judge reliability, (3) the presence of a ceiling effect which made it difficult for subjects to make larger gains.

A recommendation made by the investigators was the use of a more objective measure of performance pitch accuracy such as a machine or a computer program that would indicate pitch inaccuracies in terms of cent deviations. It was also recommended that intonational studies be conducted at the junior and senior high levels. Both recommendations have been followed in the present study with the use of the VisiNote pitch analysis computer program that analyzes pitches and yields scores in cent deviation from equal temperament, and the use of 7th graders as subjects for the experiment.

Smith (1991) investigated the development of performance pitch accuracy on string students. The two-fold purpose of this study was to measure the effects of an aural-oral pitch-matching training program on string students' aural pitch discrimination and to examine what effect improvement in aural pitch discrimination had on performance pitch accuracy. The training program utilized consisted of a set of audio pitch-matching tapes that were designed specifically for use with the TAP Pitch Master Machine (PMM). Subjects (N=96) were sixth grade students of four intact beginning string classes from two public schools. The study lasted for 16 weeks. All string classes met daily for 50 minutes. Students were randomly assigned to one of four experimental groups that were released from string classes for two 20-minute weekly training sessions with the Pitch Master Machine, or one of four control groups that performed the same exercises in class for 20 minutes without singing them.

The tapes, referred to as the Pitch Master Exercises, consisted of 45 musical exercises, 15 each in the keys of D, G, and C major. The PMM measured single voice pitches against prerecorded reference pitches. The students wore a microphone in which they sang the pitch matching responses that had to be correct within certain criteria before proceeding to next

step which was playing the exercise in their instrument. Three public school string teachers served as judges and rated the intonation accuracy of the taped exercises on a scale from 1 (excellent) to 5 (poor). Findings of the study suggest that aural-oral pitch-matching training can be used to effectively promote the development of aural pitch discrimination. Also that such training promotes the development of performance pitch accuracy. More importantly, it indicates that the treatment had a consistent effect across both aural pitch discrimination and performance pitch accuracy since the experimental group’s gains in aural pitch discrimination were accompanied by gains in performance pitch accuracy.

Heller (1987) developed a study to determine whether continuous visual reinforcement might affect students’ improvement in the area of pitch adjustment. The author surmised that if accurate visual reinforcement seems to aid auditory tasks (simply by providing an added perceptual dimension), then the use of inter modal sensory processes (vision and audition) could lead to visual programming of musical performance concepts. The purposes of the study were (a) to develop an electronic system which would be able to instantaneously write out on graph paper a meaningful display of the fundamental frequency of tones of a musical passage while the performer is actually producing the musical sounds, and (b) to determine the feasibility of utilizing these real-time graphs of performance as a teaching device and as a tool for further research. The hypothesis tested was that simultaneous visual-auditory feedback in intonation matching tasks was superior to auditory feedback alone.

A steady tone is represented by a straight horizontal line on the graph. When a tone moves up or down, the line on the graph correspondingly moves up or down. Twelve college freshman music majors participated in the study. Their task was to match the pitches of 16 graph models obtained from previously recorded musical phrases. The results of the study
demonstrated that continuous and immediate bimodal feedback (aural and visual) was more effective than auditory feedback alone in tracking fundamental frequencies of tones during musical performance.

Summary

Establishing pitch relationships is a difficult task for young string students. When performing a sequence of notes with an isolationist emphasis they achieve a disconnected rendition of a series of pitches, while a contextual approach in the performance a melody would produce a more musical result. Playing with correct intonation from a perspective of knowledge of pitch relationships is a goal that string music educators should strive for as they attempt to mold the musical minds of young instrumentalists.

The research studies reviewed in this chapter have examined the aural, visual, and kinesthetic elements of intonational accuracy. These dimensions contribute to the development of intonation, however, investigators have not yet been successful in formulating a methodology or instructional procedure that will consistently give the desired results on the development of pitch discrimination abilities in young string players.

CHAPTER 3

METHODOLOGY

This researcher investigated the relative efficacy of two instructional methodologies on the improvement of the performed intonation accuracy of seventh grade violin and viola instrumentalists. The instructional methodologies implemented in the study were aural, and aural-visual.

Subjects and Instructors

The Subjects

Subjects for the study were the students of three 7th grade intact string classes from two middle schools of the Clark County School District in Las Vegas, Nevada. All participating instrumentalists (N=68) had the same number of years of playing experience on their instruments, having received group instruction in string classes of public school
systems. To control for previous teacher or teaching

methodology effect, students that had received and/or were receiving private instruction on their instruments were not eligible to participate in the study.

The experimental groups had a non-equal but comparable number of instrumentalists which satisfied the requirement of 30-or-more subjects per experimental cell for statistical testing. This condition was met in school A with the inclusion of one class that was composed of 51 students, out of which 39 were violinists and violists, and in school B with the inclusion of two string classes of equivalent proficiency levels. Both classes in school B were taught by the same teacher and had a combined number of 56 students out of which 43 played the violin or viola.

Only violin and viola players served as subjects for the experiment, however, every student in all string classes participated in the instructional activities. Thus, the pretest and posttest were administered only to violin and viola students.

In school A the number of students who were eligible to participate in the research as subjects was 35; one violin player did not complete the treatment and did not take the posttest because of illness, bringing the final number of subjects to 34 for that group. In school B, out of 43 violin and viola students, three took private lessons, bringing the number of eligible subjects to 40. Out of this number, four did not complete the treatment due to absences, and two were unwilling to take the posttest; they were upset at the middle school director because of disciplinary measures the instructor imposed on them due to behavior problems in class. Table 1 shows the distribution of the subjects per experimental group and by instrument group.

Prior to the research all participants and their parents received information letters in which the investigator explained the purpose of the research and the procedures involved in the collection of data. Approval was also secured from the Committee for the Protection of Human Subjects of the University of North Texas (Appendix A).

Table 1

Subjects per Experimental Group

Instructional Treatment Groups 7th Graders	Instruments Violins	Violas	Totals
I. Aural methodology (n = 34)	23	11	34
II. Aural/visual methodology (n = 34)	27	7	34
Totals	50	18	68
Grand Total of Subjects			N=68

The Instructors

The selection of the schools where the experiment took place was largely dependent on the qualifications of the instructors. The investigator decided a priori that the teachers implementing the instructional activities would have to meet certain criteria.

Because the research was going to ascertain the effectiveness of the methodologies on violin and viola students, and the mode of instructional material presentation would require the teacher to model, it was essential for the instructors to have the following qualifications:

a. be a string specialist

b. have similar performance background and experience

c. be proficient in the violin or viola

d. have similar number of years of teaching experience

Two middle school orchestra directors that met the qualifications criteria, both responded positively. The teachers qualifications compared in the following manner:

	Teacher A	Teacher B
String specialist:	yes	yes
Backgroung:	master's	master's
Proficiency:	vln performer	vln/vla performer
Years teaching	10 years	8 years

Testing Material

Material used in the pre- and posttest of the present study were written by the author based on material selected by the experimenter to reflect the intervals encountered most often in the string literature for the level of the subjects tested. They also were representative of the intervals that present an intonation challenge to young string players, i.e. minor seconds, minor sixths, minor thirds. They were designed to represent level 2 difficulty in first position. The tasks included work on individual strings and string crossings.

Performance Tasks

The performance material was composed of three music tasks which were four-measure passages. Each of the music tasks was comprised of seven notes that formed six melodic intervals with a range extending from a minor second to an octave. The musical content of the performance tasks included all intervals contained within the span of a fourth on a single violin or viola string. The placement of the second and third fingers was dictated by the type of intervals (major or minor) comprised within the tetrachord(s) used in each music task.

Ten pieces written or arranged for string orchestra of level 2 of difficulty and categorized as most used by middle school orchestra directors, were reviewed to give insight into the selection of intervals.

All performance tasks had a tonal center and were playable in first position. The keys in which they were written were different for violin and viola but equivalent according to the tuning of each instrument since they involved the same strings as they relate to the instrument's fingerboard. This made the performance tasks technically of equal difficulty for both instruments.

The keys of the performance tasks were established by means of accidentals rather than key signatures in order to alleviate the situation of subjects inadvertently "forgetting" the sharps, flats, or naturals involved in each key. Forgetting the key in which the music is written can be a false and misleading indicator of faulty intonation. The three performance tasks as they were presented to the subjects were numbered No. 1, No. 2, and No. 3, to avoid any confusion in the order of presentation. (Appendix B)

Reliability and Validity of the Test Material.

The reliability of the test, or measuring instrument, used in the pretest and the posttest was determined using the Cronbach alpha coefficient. The test items were the pitches comprised in the three music tasks. As explained in the chapter III, out of the seven pitches of Task A only six were taken into account for statistical testing. Tasks B, and C provided seven pitches each.

The alpha coefficient, a lower bound test for true reliability, was used to determine the reliability of the test items. The number of items for the reliability analysis was 20, which yielded an alpha reliability coefficient of .83, indicating an acceptable degree of confidence that the subjects were in fact understanding the test (performance tasks) and answering (performing) the questions.

Content Validity of Test Items

The content validity of the music tasks was established through a questionnaire sent to six middle school orchestra directors (other than those who taught the subjects) who volunteer to participate in the survey. All of them evaluated the content of the music tasks and gave their opinion on two main questions: (a) does the material test intonation?, and (b) is the material appropriate for seventh graders? The responses of the middle school orchestra directors is presented in Table 2 and indicate that the validity of the test items received an almost perfect score, thus, establishing the content validity of the performance tasks used in the present experiment.

Table 2

Content Validity of Testing Instrument:

Responses to Content Validity Questionnaire

Respondent	Q. 1	Q. 2
1	y	y
2	y	y
3	y	y
4	y	n
5	y	y
6	y	y
Total	7	6

y = yes, n = no

The objection of respondent 4 on question 2 was that the sequence of intervals on Task 3 may have been too difficult for 7th grade viola students. However, the overwhelming concensus of the other respondents was sufficient to deem the tasks as acceptable.

Instructional Materials

The Teacher Manual

To minimize the teacher effect factor, a Teacher Manual was written in a very detailed manner for the instructors to use as a reference for all instructional procedures. The Teacher Manual was divided into two parts. The first section contained the general rules of the study, and the second part contained the Daily Instructional Activities, which comprised a step-by-step description of all the procedures including how the instructor was to verbally addressed the students in the implementation of the instructional activities.

The teacher manual included a music score that contained all the interval exercises that were the material for the instructional activities of each day. A complete sample of the Aural Teacher Manual can be found in Appendix C, of the Aural/Visual Teacher Manual in Appendix D, and of the Music Score (interval exercises) in Appendix E.

The second section of the Teacher Manual was the Daily Instructional Activities. It contained the verbal presentation procedure the teacher was to follow in each instructional session, and the teaching material written in musical score form that covered all the interval exercises that were to be played and drilled every day of the experiment. The verbal instructions, or how the instructors explained each step of the didactic process, were designed to equalize the teaching approach and effectiveness of the instructors in both groups. (Appendices C and D).

Research Design for the Main Study

A non-equivalent control group design was used to test the hypothesis of the study. It involved two experimental groups that represented the methodologies: (a) aural and (b) aural/visual. Table 3 summarizes the experimental design for the study.

Table 3

Summary of Experimental Design

Group	Task 1	Task 2	Task 3
I	01 X1 02	01 X1 02	01 X1 02
II	01 X2 02	01 X2 02	01 X2 02

Explanation of Symbols

Performance of Music Tasks

01 = Pretest

02 = Posttest

Instructional Methods (Random Assignment)

X1 = Aural methodology

X2 = Aural/Visual methodology

Experimental Procedures

The study followed a Pretest-Instruction-Posttest design. Three classes of seventh grade string students from two schools participated in the study. Students were administered a pretest using the performance test material described above. Classes then were randomly assigned to two experimental groups which were identified by instructional methodology: group A - aural training and instruction, and group B - aural/visual methodology.

Both experimental groups received a twenty-day period of Instruction during orchestra classes that met every day for fifty minutes. After the tuning of instruments had been done, the string instructor of each experimental group used 10 minutes for the implementation of the activities outlined in the Instructor's Manual and the Daily Instructional Activities for each experimental group (Appendix C).

Group A encompassed activities that addressed the aural aspect of the intonation training, Group B included the visual activities proper of the visual methodology which were carried out concurrently with the implementation of the aural procedures. Both groups covered the same musical material with different procedural steps. The Aural group listened to the pitches produced by the teacher and reproduced them, while the Aural/Visual group listened to the pitches produced by the teacher and looked at the arrangement of dots in the fingerboard that represented the notes being performed. At the end of the instructional period each student completed a posttest consisting of the same material as the pretest. Throughout the present study the intonation standard was equal temperament.

Threats to Internal Validity

Internal validity issues are a constant threat to the final results of a study. Several areas of concern should have been addressed prior to implementation of the present study.

Testing

The test-retest format using the same testing material may not have been conducive to obtaining a true measurement of intonation improvement on the second testing session, because students had already experienced the testing material and imroved due to this knowledge.

Implementation

Effort was made to equalize the teaching abilities, and thus, the effectiveness of the instructors involved in the experiment. However, individual approaches in implementing the instructional activities may have had a bearing on the results of the study. One way to solve this problem is by having the same instructor teach all classes involved in the study; a video tape recording of the teaching sessions would have given the experimenter a means for verification and critique of the instructional phase of the study.

History

There is no record of what took place in the classrooms to verify that the events that took place during the instructional time were in fact the activities precribed in the teacher manual. A video tape recording may also have documented these events.

Regression

The scores of a posttest in groups in which subjects score unsually high or low will experiment a regression toward the mean, which means that a student that scored high in the pretest may score lower in the posttest, and a student that scored low in the pretest migh score higher in the posttest only due to chance.

Testing Procedures

The data gathering process, the administration and recording of the pretest and posttest, were conducted in the schools where the subjects attended. Permission was secured from the respective principals and string instructors to involve the student sample population and for the use of facilities in each school.

Before the experiment began, subjects (N=82) were asked to complete a background information survey that was part of the assent form which all students had to fill out and sign to be able to be an active participant in the research. (Appendix A). This documented the extent of their musical training, years of playing experience on the instrument, and if they had taken or were taking any private lessons.

Tuning

One of the most important steps in training young players to perform with accurate intonation is to teach them how to tune their instruments to a pitch produced by an external source. The sound of the open fifth is indispensable to achieve the proper tuning of a string instrument, i.e. violin or viola (Galamian, 1985).

The precise tuning of each subject's instrument was crucial in obtaining an accurate production of the frequencies involved in the pitches in the musical tasks. An instrument not properly tuned would have been unsuitable for the purpose of this research.

An A4=440Hz was produced by a pitch generating electronic instrument. To verify that an instrument was in tune, the A string was checked against one of two strobo type tuners, the Korg DT-3 digital tuner, or the Yamaha TD-1 chromatic tuner. These tuning devices were also calibrated ahead of time to A4=440. When the A string was correctly tuned, the rest of the strings were tuned using the open fifth sound by playing two strings at a time. The instructors assisted in the tuning process to ensure that all instruments were accurately tuned.

After each instruments was tuned, subjects were allowed a one-minute warm up to familiarize themselves with the research environment and to test the recording room for sound response. They were permitted to sit or stand according to what they judged was the ideal setting to achieve optimal results in their playing.

Recording Procedures

After the warm-up period, subjects were given the following directions by each respective recording monitor. These instructions were read aloud:

> We are now ready to start the experiment. You will play three short musical passages of seven notes each.
>
> First, listen to the following instructions:
>
> 1. You will be given the written music for each passage. Study the music carefully so you will know how to play all notes. The three

passages will be played in first position. Please use the fingerings given above some of the notes, and do not play open strings even if it is possible to do so.

2. Please perform all pitches without vibrato, and try to maintain a constant dynamic level of ***forte(f***). Start with a down bow and change bow direction on each note.
3. Play the first note of the passage. If you have any doubt as what this note is, the instructor will help you understand it. When this is done stay in playing position and ready to start.
4. At this point you will hear four clicks of the metronome to establish the tempo at which you will play. The metronome will click at an Andante tempo of mm. ♩ = 86.
5. Start playing the passage after you hear the fourth beat on the metronome. It is important that you perform with as accurate intonation as you can. Once you start playing, please do not stop.

If you have any questions you may ask them at this time.

At this point subjects asked the questions they had and then performed the music tasks.

To control for any possible task-sequence effect, the presentation of music tasks followed a different order for each subject in both the pretest and the posttest, with the order repeating itself after every six subjects. The recording monitors had a chart and a task sheet with the order in which the tasks should be presented to each student as outlined on this sequence. The order of music task presentation is shown in Table 4.

Table 4

Order of Music Task Presentation

Subject	Music Tasks
1	A B C
2	A C B
3	B A C
4	B C A
5	C A B
6	C B A

Instructional Procedures

The instructional phase of the experiment took place every day during regular orchestra class time. The duration of each session was 10 minutes which began after the tuning of instruments had been completed. Both instructional groups had the same amount of time for the teaching period.

The sequence of instructional material was designed to cover twenty days of instruction. The implementation of the teaching sessions was done on consecutive days, except for holidays or days when other school activities prevented the normal development of class procedures.

The implementation of the instructional activities was not documented (i.e., videotaped) for future review by the experimenter of how accurately the instructors adhered to the directives set forth in the Teacher Manual. The development of the instructional sessions was left up to the discretion of the instructors, which in itself posed a threat to the internal validity of the research. It is hoped that the teachers followed the directives and used the instructional material as prescribed in the Teacher Manual.

However, there was no system in place to verify that both instructors were indeed teaching in the same manner.

The music score allowed the teachers to view what notes each instrument section was playing, the tempo, and the number of repeats of each interval exercise (Appendix E). Subjects received a daily music sheet containing the performance material (interval exercises) for their respective instruments. Instrument parts were extracted by the researcher from the music score for faithful and accurate correlation. Both the music score and instrument parts were produced using the Finale notation writing program software (Coda Music Technology, Finale 2000 – The Art of Music Notation, 2000).

Both instructors were given the Teacher Manual a week before the start of the study so they could familiarize themselves with all the details of the experiment. Also, the data collectors (recording monitors) were provided the instructions on how to use the mini disk digital recorder.

Aural Methodology

The Aural Methodology encompassed two criteria for its development: (a) the musical content composed of exercises containing intervals ranging from minor seconds to an octave in three major keys: D, G, and C, which were to be played three times, and (b) the performance of the interval exercises following the format of a teacher modeling-student imitation cycle. This required the instructor to be a proficient violin or viola player.

Aural methodology teaching process. The teaching steps for the Aural methodology were as follows: (a) instructor verbally addressed the class and explained what kind of intervals would be played that day, (b) then the instructor said “listen”, and proceeded to perform the interval with correct intonation while the students listened to the modeled presentation by the instructor. When the instructor was finished the students played the interval or series of intervals that were modeled. Each interval was performed three times following the same steps. The specifics for the implementation of the aural methodology were outlined in the

Daily Instructional Activities part of the Aural Teacher Manual. (Appendix C).

Aural/Visual Methodology

This instructional system made use of all the activities of the Aural Methodology training as outlined in its Daily Instructional Activities. In addition it included the use of a visual aid in the form of a physical representation of a violin/viola fingerboard with color coded dots: green for natural notes, yellow for sharp notes, blue for flatted notes. The visual aid was used by the teacher to illustrate the finger placement points needed to perform the pitches of an interval or a series of intervals (Appendix F).

To avoid the threat of time use to the integrity of the instructional period, and to maximize the efficiency of teaching time, the researcher provided the instructor of the Aural/Visual group four replicas of the visual aid where the dots representing the notes were placed prior to the beginning of class. This allowed the instructor to cover the same instructional material as the Aural methodology in the same amount of time. The students did not physically manipulate the visual aid, they only looked at the placement of the dots.

Aural/Visual methodology teaching process. The teaching steps for the aural/visual methodology were as follows: (a) instructor verbally addressed the class and explained what kind of intervals would be played that day, (b) then the instructor pointing to the visual aid said: “look and listen” and proceeded to perform the interval with correct intonation while the students fixed their attention on the visual aid and listening to the modeled presentation by the instructor. When the instructor was finished the students played the interval or series of intervals that were modeled. Each interval was performed three times following the same steps. The specifics for the implementation of the aural/visual methodology were outlined in the Daily Instructional Activities of the Audio/Visual Teacher Manual. (Appendix D)

Equipment

The equipment utilized in the data gathering phase of the study was the following:

1. The recording of the music task pitches was done with the Sony 687-MD mini disk digital recorder for optimal pitch reproducibility.

2. The microphone used to record the subjects was an Audio-Technica with a frequency response of 80-12,000 Hz, capable of handling all frequencies utilized in the study.

3. The program Visi-Note from the Sound Explorer Software Series made by Advantage Showare, Inc. was the measurement instrument used for pitch analysis (Advantage Showare, Inc, 1998).

4. The computer used to run the pitch analysis software was the Power PC Macintosh 1500/100 outfitted with serial ports. Even though this was an older model computer, the researcher opted to use this equipment to prevent having to use port connectors needed to enable a newer computer to work with the Sound Explorer software. All computers are now equipped with USB ports instead of serial ports.

5. The audio playback to carry out the pitch analysis was done with a set of mini Toshiba speakers to achieve a faithful reproduction of the digital recordings.

6. The McAdams electronic tuner was used to provide the A440 to which all A strings were tuned (both schools had one of these instruments).

7. The Korg DT-3 digital tuner was used in School A to double check the tuning of the A strings.

8. The Yamaha TD-1 chromatic tuner was used in School B to double check the tuning of the A strings.

Pilot Studies

First Pilot Study

A pilot study was carried out for the purpose of getting acquainted with all the components of the recording equipment. Since the experimenter would have only one opportunity to collect data from each subject it was crucial that the equipment worked properly.

Six ninth grade students, three violinists and three violists, were the subjects for the pilot study. Subjects performed the three music tasks used in the study. Each pitch had the duration of a half note played at an andante tempo with a metronome speed of mm. • =86. The length of each pitch was about one second. This length was sufficient for the Sound Explorer to analyze each note.

The headband microphone was set up on a microphone stand to minimize the distraction element and to avoid any discomfort or annoyance to the players. The researcher encountered some difficulties in getting clean readings by the VisiNote due to factors like bow pressure, bow attack, dynamic level, and distance from the microphone, which affected the sound input due to the extreme sensitivity of the Sound Explorer microphone and the pitch analyzing program itself that read the minimal change in frequency. The researcher felt that a better data gathering process was necessary.

Second Pilot Study

Because of the difficulties encountered during the first pilot study in which the VisiNote program was used to record the subjects directly into the Macintosh computer, a second pilot study was carried out to ascertain if a different recording procedure would be more advantageous.

First, the pitch analysis accuracy of the VisiNote from playback of prerecorded pitches was tested. The recordings were made using a portable pocket size mini cassette tape recorder. The VisiNote read and analyzed all pitches from the mini cassette recorder without problems. The researcher surmised that if the pitch analysis program could perform a faithful reading from a pocket-size, low quality recording device, a more advanced and reliable portable recorder would achieve the accuracy of pitch readings acceptable for the analysis of the study. It was decided that the best data gathering procedure to avoid the risk of having to repeat each recording more than once was to record all subjects into a portable recording device that would provide the quality sound to feed into the computer program for cent analysis.

A mini disk digital recorder was the best portable sound recording device available. The researcher opted for using the Sony 687-MD mini disk recorder for the data gathering phase of the study, it was accurate and easy to use.

The subjects for the second pilot program were six seventh grade violinists and violists from a school that did not provide subjects for the experiment. They performed the three music tasks into the Sony 687-MD mini disk digital recorder via an Audio-Technica vocal or instrumental microphone. The recordings were clean and pitches were properly analyzed by the VisiNote pitch analysis computer program.

Pitch Analysis

The VisiNote Program

The pitch analysis of the music tasks was carried out using the Visi-Note pitch analyzer of the Sound Explorer (1999) program developed by Advantage Showare, Inc. It was run by the Power Macintosh 7500/100 computer. The program was developed to measure pitch deviation in cents from the equi-tempered system of notes produced instrumentally or vocally.

The seven pitches of each music task were recorded without a pause, as a single musical line. The duration of each recorded pitch was one second which was sufficient for the VisiNote to graph it and analyze it.

The VisiNote pitch analyzing program worked in the following manner:

1. The sound or pitch of a note was fed into the hardware of the VisiNote via a headphone microphone provided by the program maker.

2. The VisiNote then created a graph which showed a line that was shaped according to the contour of the series of pitches involved, as well as the dynamic level or volume of the notes.

3. The VisiNote then gave the opportunity to set the "boundaries" of the sound. The boundaries of the sound were the amount of pitch that would be analyzed, and which is determined or set by specific dynamic levels chosen a priori by the experimenter.

4. After the boundaries were set, the program presented the choice of viewing an intonation tendency chart, which

was a graph that included every note or pitch performed with a calibration of its deviation from the equal temperament standard. It named the notes by their sound, D, E, G, F# etc. So, if the pitch of a G was sharp by +55 cents of deviation it was reflected as a G# with a deviation of -45 cents.

5. Once the graph and the cent deviation for each note of a task were presented, the VisiNote was ready to analyze the next sequence of pitches.

Number of Analyzed Pitches

The three performance tasks utilized seven pitches each, making a total of twenty-one, however, only twenty pitches were able to be analyzed, six from Task A and seven each from tasks B and C. This was decided by the experimenter after listening to the pretest recordings. In the recording instructions the following passage was read to the subjects:

> “Please use the fingerings given above some of the notes, and do not play open strings even if it is possible to do so.”

The fourth note on the first music task is an A for violins and a D for violas. The researcher had written the number 4 above the note to indicate that it should be played with the fourth finger. Not all students performed it in that manner, some played the open string, while others used their fourth finger. Most of the students who used fourth finger were noticeably out of tune. This situation prompted the researcher to decide not to use that specific pitch in the cent analysis nor in the statistical testing, since it would be a source of unexplained pitch deviation. As a result only six pitches from Task A were reported and analyzed. Subjects were not made aware of this situation and they performed the seven pitches of Task A in the posttest as they did in the pretest.

Reliability of the Pitch Analysis Instrument

The equipment and procedures for the frequency analysis to be used in the study were tested for reliability of measurement. To verify how consistent the calibration analysis of a pitch was on two different trials the test-retest method was used. The following procedures were undertaken:

1. To avoid discrepancies, two electronic instruments capable of generating constant frequencies were chosen to produce pitches of certain frequencies without variations or fluctuations: (a) a tuning instrument with variable pitch and (b) a synthesizer were tested with a strobo tuner to ensure that both produced similar frequencies. Both produced accurately an A4 calibrated at 440Hz. These pitches were analyzed with the VisiNote software on two trials with results showing .02 and .01 of absolute pitch deviation.

2. Six different pitches, two from each of the three music tasks, were selected to be analyzed for a total of twenty-four notes. The tuning instrument produced twelve pitches and the synthesizer produced twelve, which were analyzed with the VisiNote software. There were two trials for each note, performed with one-minute of time spacing between them. Results revealed that all pitch analyses were correct when compared to the frequencies produced by the pitch producing instruments, thus, establishing the reliability of the analysis instrument

Reliability of the Sound Explorer

The following statements regarding the precision and reliability of the VisiNote pitch analyzing program of the Sound Explorer were provided by Allen Goodwin, the maker of the program:

a. The precision of this instrument is controlled by a crystal control clock. Its frequency measurement precision is within (+-) 200 nanoseconds. That is 1/5 of a millionth of a second.

b. It is calibrated with an instrument that adjusts the crystal clock to a frequency that is a standard in the Office of Standards of Measurement.

c. The area with the least accuracy is at the high end of the range and is less than a 10th of one cent. In the lowest end the accuracy is less than a 100th of one cent.

d. The precision of this instrument is far greater than that of human ears.

Data Analysis

The aural methodology served as a leveling device for the experiment because both groups received this instruction. It was surmised that if both groups were equivalent in aural ability, the effectiveness of the aural training would be similar on all subjects. Any changes of differences beyond the effect of the aural methodology could be attributed to the visual instructional treatment of the aural/visual methodology

Analysis of variance was the statistical procedure utilized to test the hypotheses of the study. The data of the study were the absolute pitch deviation scores from the pretest and posstest. The ANOVA on the pretest scores was used to determine whether significant differences in the intonation ability of the groups existed. If the difference in the pretest ability to play in tune between the groups was not significant, then the scores from the posttest would be used to ascertain any difference in intonation ability between methodologies after the instructional treatment.

CHAPTER 4

RESULTS

The data for the study were the scores assigned to the subjects of both experimental groups for the pretest and posttest. These were collected and analyzed statistically to give insight into the research question for the study: Which methodology is more effective in improving the intonation accuracy of seventh grade violin and viola students: (a) an aural training, or (b) an aural/visual methodology?

Subjects were tested individually and received numerical scores that indicated the absolute pitch deviation from equal temperament of all pitches performed. Each subject received a score based on twenty notes. The same procedures were followed for both the pretest and the posttest.

Absolute Deviation

The absolute pitch deviation of a note is the total amount of out-of-tuneness, in cents, from the target pitch, regardless of the direction in which the pitch deviates, sharp or flat. A signed deviation indicates the direction in which the pitch is faulty. For instance, the signed deviation of a sharp note could be +16, and that of a flat note could be -24. Whereas the absolute deviation value of the same notes would simply be 16 and 24. The magnitude of pitch deviation (out-of-tuneness) of the experimental group was indicated by the total mean pitch deviation for each entire group. This figure was calculated by averaging the absolute pitch deviation of all subjects.

A subject's pitch deviation mean represents the averaged pitch deviation from equal temperament of all the notes performed by that subject. A lower mean indicates that a player is performing with some degree of accuracy, perhaps not very distant from the target pitch, while a higher mean denotates that the accuracy of the subject's intonation is far from the target pitch, and consequently more out of tune. For example, a score or mean of 8 would be representative of someone who is playing most of the notes in tune; a mean of 42 would indicate that a player's intonation ability is faulty, needing larger adjustments to enact pitch correction. The range of possible scores is 100, going from

Table 5

ABSOLUTE PITCH DEVIATION RROM EQUAL TEMPERAMENT

AURAL METHODOLOGY

PRETEST and POSTTEST

Subj.	Inst.	Pretest			Posttest		
		Total	Mean	SD	Total	Mean	SD
1	vln	364	18.20	11.27	324	16.20	6.65
2	vln	494	24.70	14.04	224	11.20	5.30
3	vln	458	22.90	13.54	379	19.95	8.83
4	vln	438	21.90	9.44	324	16.20	5.65
5	vln	546	27.30	10.56	355	27.30	7.61
6	vln	625	31.25	10.03	525	26.25	8.64
7	vln	622	31.10	12.99	454	22.70	5.53
8	vln	629	31.45	11.68	423	21.15	5.60
9	vln	536	36.80	8.43	360	18.00	7.13
10	vln	655	32.75	11.22	453	22.65	6.43
11	vln	559	27.95	10.51	420	21.00	14.98
12	vln	563	28.15	12.13	606	30.30	19.98
13	vln	651	32.55	10.81	511	25.55	13.18
14	vln	747	37.35	24.49	528	26.40	17.95
15	vln	656	32.80	12.63	423	21.15	12.01
16	vln	638	31.90	10.07	589	29.45	7.86
17	vln	566	28.30	9.71	314	15.70	8.86
18	vln	746	37.30	19.44	530	26.50	13.35
19	vln	477	23.85	9.06	427	21.35	9.68
20	vln	475	23.75	11.15	384	19.20	6.20
21	vln	510	25.50	10.37	407	20.35	5.16
22	vln	491	24.55	17.42	394	19.70	7.46
23	vln	504	25.20	12.03	410	20.50	15.45
24	vla	507	25.35	11.20	428	21.40	11.12
25	vla	498	24.90	14.76	491	24.55	15.67
26	vla	514	25.70	10.87	372	18.60	12.98
27	vla	518	25.90	13.71	578	28.90	12.19
28	vla	583	29.15	14.16	581	29.05	13.22
29	vla	438	21.90	14.65	411	20.55	13.92
30	vla	650	32.50	12.52	580	29.00	17.98
31	vla	616	30.80	13.55	462	23.10	15.86
32	vla	484	24.20	11.38	581	29.05	10.52
33	vla	649	32.45	13.10	413	20.65	13.48
34	vla	557	27.85	11.53	528	26.40	11.41

Table 6

ABSOLUTE PITCH DEVIATION FROM EQUAL TEMPERAMENT

AURAL/VISUAL METHODOLOGY

PRETEST AND POSTTEST

Subj.	Inst.	Pretest			Posttest		
		Total	Mean	SD	Total	Mean	SD
1	vln	802	40.10	24.02	469	23.45	11.48
2	vln	552	27.60	13.92	475	23.75	11.28
3	vln	604	30.20	20.58	649	32.45	17.46
4	vln	559	27.95	17.36	364	18.20	8.98
5	vln	482	24.10	14.48	287	14.35	4.38
6	vln	321	16.05	6.61	280	14.00	4.96
7	vln	525	26.25	14.81	244	12.20	7.27
8	vln	448	22.40	16.18	304	15.20	6.61
9	vln	740	37.00	23.34	430	21.50	8.56
10	vln	526	26.30	8.54	414	20.70	14.78
11	vln	530	26.50	12.18	337	16.85	7.98
12	vln	518	25.90	14.48	323	16.15	5.74
13	vln	528	26.40	9.88	413	20.65	10.82
14	vln	485	24.25	13.66	322	16.10	6.48
15	vln	452	22.60	14.25	503	25.15	10.48
16	vln	433	21.65	8.79	400	20.00	8.28
17	vln	450	22.50	13.64	345	17.25	6.12
18	vln	475	23.75	15.82	504	25.20	10.95
19	vln	490	24.80	14.17	357	17.85	6.68
20	vln	523	26.15	12.53	453	22.65	15.53
21	vln	453	22.65	12.00	407	20.35	11.01
22	vln	804	40.20	15.70	386	19.30	7.94
23	vln	558	27.90	14.94	425	21.25	9.69
24	vln	519	25.95	12.71	355	17.75	8.04
25	vln	468	23.40	12.86	683	34.15	20.26
26	vln	585	29.25	10.69	549	27.45	8.92
27	vln	677	33.85	17.67	397	19.85	8.44
28	vla	478	23.90	18.21	425	21.25	11.16
29	vla	473	23.65	17.88	515	25.75	9.79
30	vla	617	30.85	20.95	404	20.20	12.75
31	vla	527	26.35	19.75	387	19.35	10.04
32	vla	484	24.20	19.15	529	26.45	12.30
33	vla	405	20.25	15.85	483	24.15	16.54
34	vla	427	21.35	16.46	402	20.10	8.52

0 to 50, above or below the target pitch, depending whether the pitch produced is sharp or flat. Each subject's total absolute pitch deviation score, mean, and standard deviation in the pre- and posttest for the aural group are presented in Table 5. The same scores for the aural/visual group are presented on Table 6. The absolute deviation scores by pitch for all subjects is found in Appendix G.

Data Analysis

Means and Standard Deviations

The means and standard deviations (SD), of both the pretest and posttest for the entire test of the aural and aural/visual experimental groups, are reported in Table 9. The total means for the pretest and the posttest are the averaged absolute pitch deviation of the twenty pitches for all subjects in the two groups.

Table 7

Means and Standard Deviations for the Aural and Aural/Visual Experimental Groups in the Pre-test and Post-test

Groups	Aural	Aural/Visual	
Source			Total
Pretest			
Subjects (n)	34	34	N=68
Means	27.88	26.35	27.11
SDs	4.43	5.21	4.86
Posttest			
Subjects (n)	34	34	N=68
Means	22.33	20.91	21.62
SDs	4.66	4.88	4.78

Analysis of Variance

The main purpose of the experiment was to compare the effectiveness of the two teaching methodologies, aural and aural/visual. A non-equivalent control group design was followed in order to make this comparison.

Data from the pretest and the posttest for both experimental groups was tested with ANOVA. The ANOVA for the pretest scores was used to determine significant differences between groups. The ANOVA results of the pretest for the aural and aural/visual groups are presented on Table 10. The F value was 1.72 with a p value of .194, not statistically significant at the .05 level, indicating that both experimental groups were similar in their ability to play in tune on the pretest.

Table 8

Analysis of Variance for the Pretest

Aural and Aural/Visual Experimental Groups

Source	SS	df	MS	F	p
Between	40.22	1	40.22	1.72	.194
Within	1,543.61	66	23.38		
Total	1,583.84	67			

Since the prestest scores showed no difference between the groups, an ANOVA on the posttest scores would determine if one of the methodologies was significantly better in producing an improvement. Table 9 presents the ANOVA for the posttest of the two experimental groups. The F value of 1.52 with a p value of .222, yielded no statistically significant difference between the two methodologies at the .05 level.

Table 9

Analysis of Variance for the Posttest

Aural and Aural/Visual Experimental Groups

Source	SS	df	MS	F	p
Between	34.52	1	34.52	1.52	.222
Within	1,499.14	66	22.71		
Total	1,533.66	67			

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of the study was to make a comparison between two instructional strategies designed to improve the intonation accuracy of seventh grade violin and viola instrumentalists: (a) aural and (b) aural-visual. Both teaching approaches were compared to determine which methodology was more effective in producing an improvement in the intonation accuracy of the students.

Sixty-eight violinists and violists of three string classes from two middle schools participated in the experiment. The two schools were randomly assigned to the experimental groups. School A (n=34) was assigned the aural methodology, school B (n=34) the audio/visual methodology.

Both methodologies incorporated daily exercises written by the researcher specifically for the study. The presentation of the exercises in the aural training methodology followed teacher modeling-student imitation cycles; the aural/visual methodology added a visual aid -- a violin/viola fingerboard with color coded dots to demonstrate the finger placement spots on the strings to achieve certain pitches.

The research design was a non-equivalent control group. The use of the aural methodology in both groups served as a common factor leading to isolation of the visual methodology.

The efficacy of the methodologies was determined using a pretest-posttest format. A comparison was established through statistical testing procedures using analysis of variance in order to determine the effectiveness of the teaching methodology.

The instructional process was implemented daily during twenty days for ten minutes each day. The teaching material was written for all instruments: violins, violas, cellos, and basses, to facilitate the inclusion of all members of the intact class in the instructional activities. However, only the violin and viola players were the subjects for the study. The requirements for participation eligibility were: (a) not to have taken private lessons prior to or during the experiment, and (b) to remove all tapes, dots, or other finger placement visual devices off their instrument fingerboard.

The instructors for the project had to meet the criteria of equivalent qualifications in regard to academic preparation, primary instrument, instrumental proficiency, and number of years of teaching experience. To ensure that both teachers were implementing the instructional activities on an equal basis in each class, the researcher provided them with a Teacher Manual that included a Daily Instructional Activities with the music score of all the interval exercises and scales that were to be used in each teaching session for both groups.

The music material covered the performance and drill of intervals and scales that were to be taught through a series of teacher demonstration-student imitation cycles. Instructors were requested to adhere to the step-by-step procedures to maximize the effectiveness of the methodologies, and to control for teacher effect as much as possible.

The pretest was conducted during the week prior to the start of the experiment, and the posttest was done the week after the instructional phase of the study had concluded. The same testing material was administered in the pretest and posttest sessions: three performance tasks composed of seven notes each, which were played as three separate phrases. Subjects' performances were recorded with a mini disk digital recorder, and were analyzed with the VisiNote computer pitch analyzing program. Analysis of variance was used to determine differences between the two instructional methodologies.

Findings

The research question posed at the outset of the experiment was: which methodology is more effective in improving the intonation ability of seventh grade violin and viola students, (a) an aural methodology that incorporates interval exercises implemented through teacher demonstration-student imitation cycles, or (b) an aural/visual methodology that encompasses the activities of the aural training combined with a visual teaching strategy that makes use of a visual aid in the form of a violin/viola fingerboard indicating the pitch points on the strings to facilitate left hand finger placement? In the light of the statistical testing of the data the main finding of the study was that neither, the aural or aural/visual methodologies, were significantly effective in producing better results.

Conclusions

Examining the results of the statistical analysis of the data the following conclusion may be drawn in regard to the research question. The implementation of an aural/visual teaching methodology that used a visual aid was not significantly more effective than the aural training program designed to teach intonation skills through a teacher modeling-student imitation process on the improvement of the intonation accuracy of seventh grade violin and viola string instrumentalists.

The results of the present experiment concur with the results of the Smith studies (1985, 1987) that examined the effects of finger placement markers on the intonation improvement of non-string college music students, and elementary school beginning string students. In both studies the results were non significant on the intonation improvement of the subjects. The results of the present study, however, do not agree with Bergonzi's (1991) findings that showed a significant improvement on the intonation of the fourth grade subjects that were exposed to tape recorded models and used finger placement markers.

Several conditions that posed a threat to the internal validity of the study may have influenced the results of the experiment. Controls were not established in the research design to monitor conditions such as testing, implementation, history, and regression. If these controls had been in place, results might have been different.

Recommendations for Future Research

Results from this study did not provide answers to the ongoing debate in string education concerning the use of visual aids to improve intonation. Visual devices may be helpful, but without training of aural ability these may not have lasting results.

A replication of the present study is desirable, with the implementation of some procedural revisions or changes such as fewer interruptions in the implementation of the instructional treatment either from holidays or other activities in the school. This will help achieve a smoother, and perhaps more efficient implementation of the instructional methodology, which may affect the effectiveness of the methodologies.

A better understanding by the instructors involved of the research procedures might have focused the attention of the students more effectively. Research of this nature often conflicts with the daily demands of the string teachers and students.

Also, it will of interest to the string educators to conduct a study using an instructional approach that incorporates visual and kinesthetic activities which might yield better intonational results. Since string playing requires an interaction of aural, visual, and tactile experiences a methodology encompassing this elements might be warranted.

APPENDICES

APPENDIX A

LETTERS AND

CONSENT FORMS

A STRING RESEARCH PROJECT
Parent Information Letter

March 21, 2001

Dear String Parents:

I am a doctoral candidate at the University of North Texas, and as such, I will be conducting a string research study. I want to extend an special invitation to each string student to be a participant in this project. The purpose of the study is to establish a comparison of two instructional methodologies designed to improve the intonation accuracy of middle school string players.

My goal is to provide in a practical and effective way the tools that will help young string instrumentalists expand their understanding of pitch discrimination, and as a consequence, improve their ability to play with correct intonation. The research will take place in your child's school campus. Participants will be asked to play three short musical phrases composed specifically for the study. This will be done at a time that will be convenient for the student and the researcher.

Participation in this project is voluntary, and the student may withdraw from it at any time without fear of penalty or loss of privileges. The study is being done in connection with de College of Music of the University of North Texas, and has been reviewed and approved by the UNT Committee for the Protection of Human Subjects (940) 565-3940. The main researcher is Mr. Mario Núñez (702) 395-1176, and the research supervisor is Dr. Darhyl Ramsey (940) 565-3749.

Thank you for allowing your child to be part of this exciting string research. Please read the enclosed consent form, sign it, and return it to your child's orchestra director as soon as possible. You may keep this letter, return the consent form only.

Best wishes to your child for a successful and enjoyable experience in string playing.

Sincerely,
Mario Núñez
Doctoral Candidate
University of North Texas

A COMPARISON OF AURAL AND VISUAL METHODOLOGIES DESIGNED TO IMPROVE THE INTONATION ACCURACY OF SEVENTH GRADE STRING INSTRUMENTALISTS

PARENT CONSENT FORM

I have been informed about the research that will be conducted on the intonation accuracy of seventh grade string instrumentalists. I fully understand the purpose of this study and grant permission to my child to participate as a subject.

I understand that participants will be asked to play three short musical phrases composed specifically for the study. I also undertstand that the data collected by the researcher will become part of a dissertation project, and give him permission to use this data. I understand that my child’s identity will be concealed and that my child will have an identification code that only the researcher will know. I also understand that the results of this research might be used for a presentation at professional meetings, and/or submitted for publication in professional journals, and that in all cases my child’s identity will remain anonymous.

Furthermore, I understand that my child may withdraw from the research, or ask that his/her data not be included in the research, at any time without fear of penalty or reprisal. If I have any questions regarding this research I may contact Mr. Mario Núñez at (702) 799-3440 x.259 or (702) 395-1176.

The study is being done in connection with the College of Music of the University of North Texas, and has been reviewed and approved by the UNT Committee for the protection of Human Subjects (940) 565-3940. The main researcher is Mr. Mario Núñez (702) 395-1176, and the research supervisor is Dr. Darhyl Ramsey (940) 565-3749.

By signing this form, I realize that I am giving my child my informed consent to participate in this string research.

Please print.

Student’s Name __________________________ School ____________________

Grade _________ Phone __________________ Instrument ________________

______________________________________ ____________________

parent’s signature date

A STRING RESEARCH PROJECT
Student Information Letter

April 2, 2001

Dear String Students:

I am a doctoral candidate at the University of North Texas, and as such, I will be conducting a string research study. I want to extend an special invitation to each of you to be a participant in this project. The purpose of the study is to establish a comparison of two instructional methodologies designed to improve the intonation accuracy of seventh grade string players.

My goal is to provide in a practical and effective way the tools that will help young string instrumentalists expand their understanding of pitch discrimination, and as a consequence, improve their ability to play with correct intonation. The research will take place in your school campus. As a participant you will be asked to play three short musical phrases composed specifically for the study. This will be done at a time that will be convenient for you and me.

Participation in this project is voluntary, and you may withdraw from it at any time without fear of penalty or loss of privileges. The study is being done in connection with de College of Music of the University of North Texas, and has been reviewed and approved by the UNT Committee for the protection of Human Subjects (940) 565-3940. The main researcher is Mr. Mario Núñez (702) 395-1176, and the research supervisor is Dr. Darhyl Ramsey (940) 565-3749.

Thank you for accepting to be part of this exciting string research. Your participation will be invaluable for the success of this project. Please read the enclosed consent form, sign it, ask your parents to read it, and return it to your orchestra director as soon as possible. You may keep this letter, return only the consent form: yellow for violins, orange for violas, or green for cellos and basses.

Best wishes for a successful and enjoyable experience in string playing.

Sincerely,

Mario Núñez
Doctoral Candidate
University of North Texas

A COMPARISON OF AURAL AND VISUAL METHODOLOGIES DESIGNED TO IMPROVE THE INTONATION ACCURACY OF SEVENTH GRADE STRING INSTRUMENTALISTS

SUBJECT ASSENT FORM

I have been informed about the research that will be conducted on the intonation accuracy of seventh grade string instrumentalists. I understand the purpose of this study and voluntarily wish to participate as a subject.

I understand that as a participants I will be asked to play three short musical phrases composed specifically for the study. I understand that my identity will be concealed and that I will be assigned an identification code that only the researcher will know. I also understand that the results of this study might be used for a professional presentation, and/or submitted for publication in professional journals, and that always my identity will remain anonymous.

Furthermore, I understand that I may not continue as a participant in the study at any time without fear of being punished. If I have any questions regarding this research I may contact Mr. Mario Núñez at (702) 799-3440 x.259, or (702) 395-1176.

The study is being done in connection with the College of Music of the University of North

Texas, and has been reviewed and approved by the UNT Committee for the Protection of Human Subjects (940) 565-3940. The main researcher is Mr. Mario Núñez (702) 395-1176, and the research supervisor is Dr. Darhyl Ramsey (940) 565-3749.

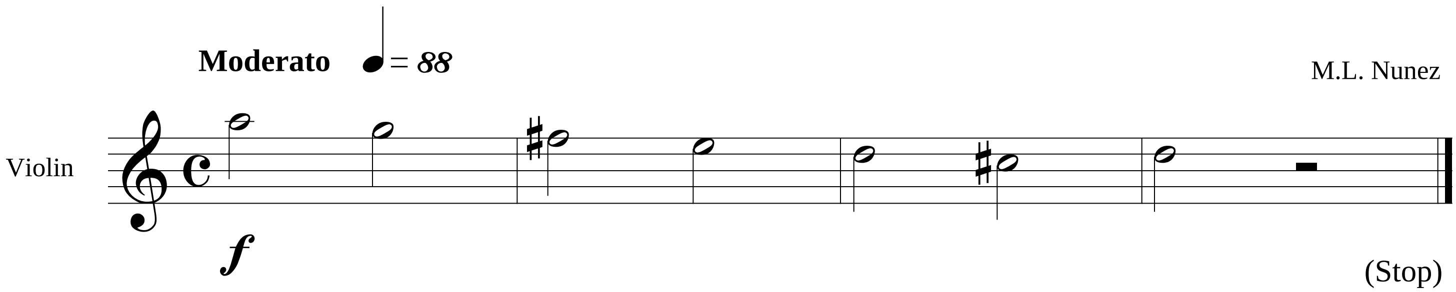
By signing this form, I realize that I am voluntarily accepting to participate inthis string research.

APPENDIX B

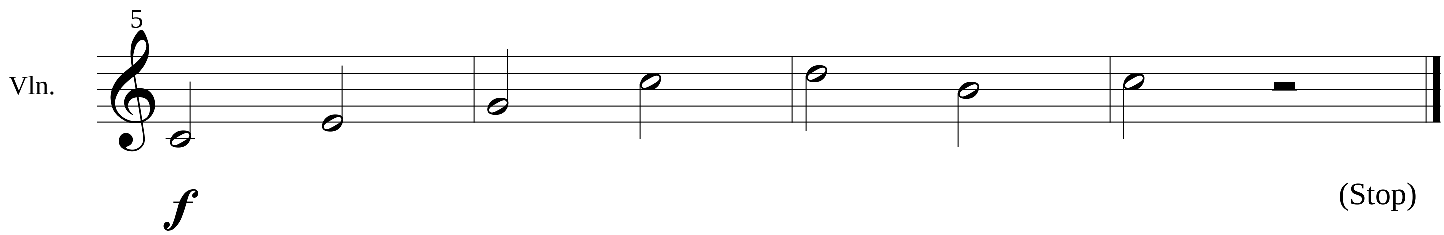
PERFORMANCE TASKS

Music Tasks
VIOLIN

No. 1



No. 2



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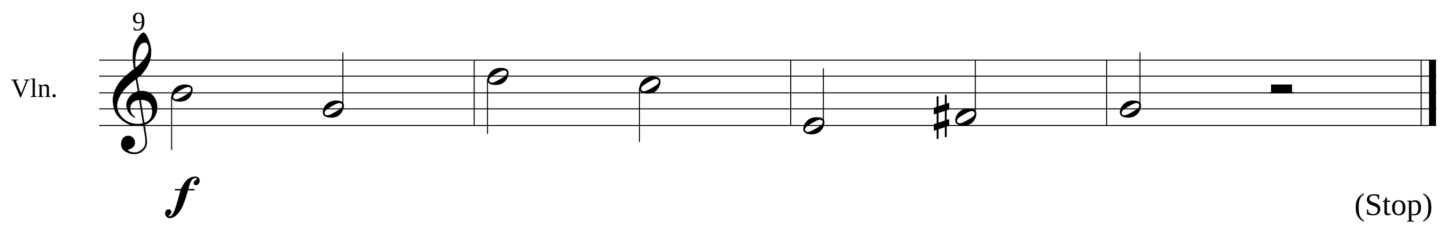
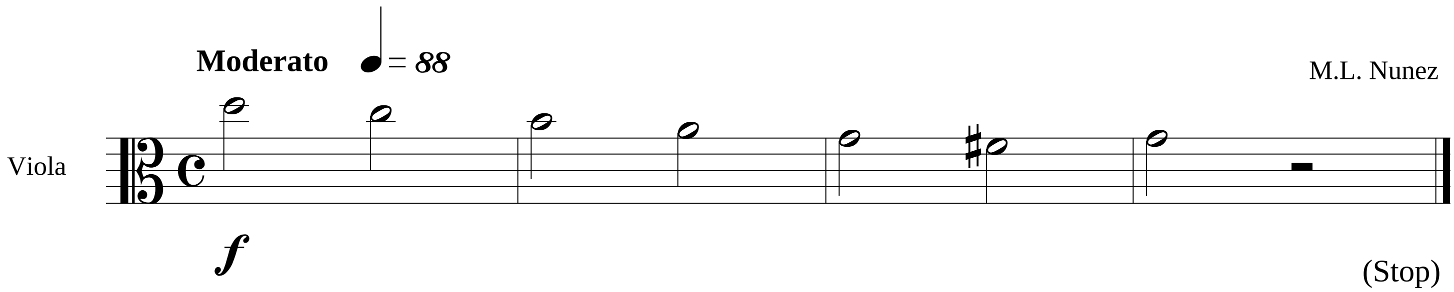


Music Tasks
VIOLA

No. 1



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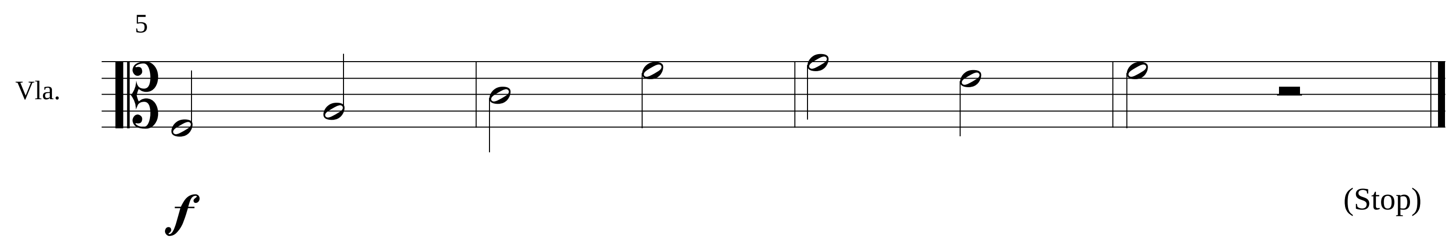

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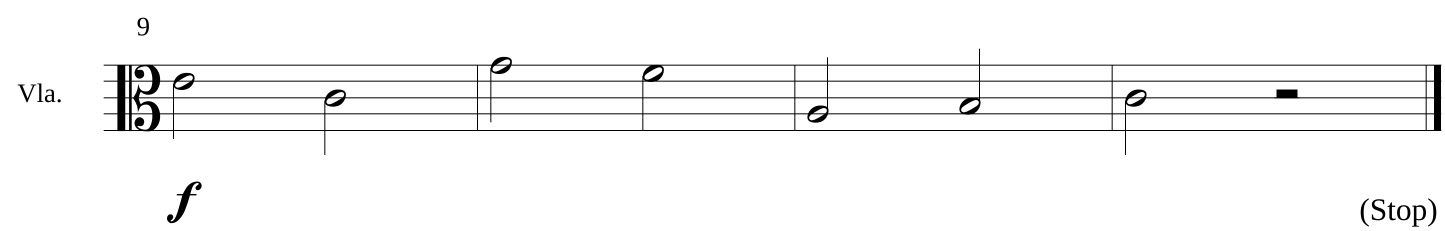


APPENDIX C

TEACHER MANUAL
AURAL METHODOLOGY

TEACHER MANUAL
AURAL METHODOLOGY

PART I
INTRODUCTION

TEACHER MANUAL

AURAL METHODOLOGY

Introduction

The aural methodology will encompass the training of pitch discrimination and the attainment of improved performed intonation from an aural (listening) approach. Subjects will be given a pre-instructional test to determine the level of each student's intonational accuracy, and a post-instructional test to assess the students' performed intonation improvement, if any.

The treatment will be implemented during twenty days and will last **only** ten minutes of each class period. It will encompass specific instructional strategies designed to give the string player a better understanding of pitch relationships, left hand finger placement, and how these affect the accuracy of intonation. At the end of the ten-minute instructional time the instructor will **stop** all instructional activities.

Verbal Communication

Verbal communication will be the means by which the instructor will convey or explain to the students:

(a) concepts involved in performed intonation: i.e. interval distances

(b) procedural directives as outlined in the instructional steps.

Sequence of activities.

The activities for each day of the four weeks of instruction will be delineated in a very detailed manner in the **Daily Instructional Activities** section of this manual.

Tuning

Students' instruments will be tuned on a daily basis to A-440. The electronic instrument used will reproduce an audible sound of said note so that all students can hear it and can develop an aural recognition of that pitch.

The tuning process, however long it may be, will not be counted as part of the ten minute instructional time.

Materials

The researcher will provide the student materials (interval sheets) to be used each day during the instructional time. Keys are established by means of accidentals, since this is the manner in which the music tasks are written.

The Aural Methodology instructor **MAY NOT:**

(1) Physically show finger placement to the students

(2) Draw on the blackboard dots showing finger patterns

(3) Show pitch location on the strings in any way, shape, or form

(4) Add any accidentals to create more or new intervals. For the purposes of this research the intervals used will be those comprised in the keys of C, G, and D major in first position.

AURAL INSTRUCTIONAL PROCEDURES

Teacher Modeling

Teacher modeling will be the pedagogical tool used in the aural training of intonation. The modeling of pitches by the instructor will include (a) the performance of notes with accurate intonation, and (b) the imitation of the students with the goal of reproducing the notes involved in the presentation with correct intonation as they heard them.

Procedures for the teacher modeling-student imitation activities are as follows:

(a) Using a violin or a viola the teacher will model the production of notes with correct intonation.

(b) Students will listen discriminately and then will reproduce the pitches they heard.

(c) The teacher modeling-student imitation process (one complete set of modeling-imitation cycle) will be repeated three times for each interval addressed.

(d) There will be no feedback from the instructor as to how well or how poorly the students are performing.

Instructional Procedures

The following steps are involved in the instructional phase of this research:

(1) **Introduction of concepts.** This will take place on the first day of the instructional treatment, and will be applied and reiterated every day during the instructional activities time.

(2) **Teacher modeling:** this involves the performance-demonstration by the teacher as described above.

(3) **Students' imitation** response. This will comprise two actions:

(a) **listening** to the notes as the teacher performs, and

(b) **reproducing** the pitches performed by the instructor

I. Introduction of concepts.

Teacher will explain the following concepts on the first day of the instructional period:

- Intonation
- Intervals
- Whole step
- Half step

Please refer to Part II of the Teacher Manual, **Daily Instructional Activities,** for an step-by-step description of the presentation of concepts. It also contains the implementation sequence of the activities of the Aural intonation training.

II. Teacher modeling or performance-demonstration.

After concepts have been clearly explained to the students the teacher will proceed to apply them in the aural training.

(1) The teacher will address the students verbally establishing all procedures according to the Daily Instructional Activities

(2) Teacher will get ready for the performance-demonstration, and will produce a clear tone at a forte dynamic level.

(3) After the teacher modeling-performance the students will reproduce the notes they heard.

(4) Instructor will remind the students the key they are performing in.

(5) Each interval will be repeated three times. Between trials of the same interval the teacher will remind students to:

(a) **listen** to:

- the performed pitches
- the pitches they are producing, and

(b) **adjust** their fingers as they play, if needed, to play pitches in tune.

(6) Teacher will perform **once** a one-octave scale each day

to close the instructional time, students will imitate in the same manner as they did with the intervals.

III. Students' response.

Prior to the teacher modeling students will be asked to:

(a) **listen** to the pitches performed by the instructor

(b) **reproduce** as accurately as possible the pitches they hear when the instructor gives the command.

Instructional Material

(a) The intervals to be performed will be in the keys of D, G, and C. The intervals involved are:

- major and minor seconds
- major and minor thirds
- perfect fourths and fifths
- major and minor sixths
- octaves

(b) The intervals used will be those comprised in those keys, and are playable in first position.

Expectations

At the end of the instructional period it is hoped that: (1) students will be familiar with the following concepts and terminology:

(a) Intonation

(b) Interval - the distance between two notes

(c) Half step - shortest distance possible between two notes

(d) Whole step - distance equal to two half steps

(f) Clear understanding of accidentals: sharps, flats, naturals.

(e) Dynamics: mf (mezzo forte), f (forte)

(2) students will understand and attain a degree of proficiency performing the following intervals in the keys of D, G, and C:

(a) major and minor seconds (on the same string)

(b) major and minor thirds (on one or two strings)

(c) perfect fourths (on one or two strings)

(d) perfect fifths (on two strings)

(e) major seventh (leading tone)

(f) octave (open string and 3rd finger on two adjacent strings, 3rd and 2nd fingers on two non-adjacent strings)

PART II

DAILY INSTRUCTIONAL ACTIVITIES
AURAL METHODOLOGY

DAILY INSTRUCTIONAL ACTIVITIES
AURAL METHODOLOGY

Day 1

Presentation of concepts. The instructor will present to the students four basic concepts necessary in the teaching of intonation, explaining them verbally in the following manner:

"Today we are going to learn more about playing with correct intonation. There are four basic concepts involved in playing with accurate intonation.

First, let's define what is intonation. Intonation, or playing in tune, is the production of musical notes according to a pitch standard or model.

(a) "If a note is played above the standard it is considered high or sharp and consequently, not in tune." Demonstrate playing E on the D string.

- first play it with correct pitch saying "here is the model or standard"
- then make it sharp saying "this is too sharp and consequently out of tune"
- then bring it back to pitch saying "To correct that note

I need to adjust my first finger so I can play it according to the standard”.

(b) “If a note is played below the standard it is low or flat and also not in tune.” Demonstrate playing D on the A string.

- first play it with correct pitch saying “here is the standard”
- then make it flat saying “this is too low and out of tune”
- then bring it back to pitch saying “To correct that note I need to adjust my third finger so I can play it according to the standard”.

(c) “Playing in tune then means that each note be accurately reproduced according to the standard.

To achieve this first you must listen very carefully to the standard:

- to know what the pitch sounds like, and
- to have mentally a pitch that you can aim for when you play.

If you aim too high you must then adjust your fingers to bring the pitch lower just like I did it when I play that E too sharp; and if you aim to low you also need to adjust your fingers to bring the pitch higher, just like I did it when I played that D too low.”

“Interval. It is the distance between two notes. An interval takes its name according to the number of notes, of different name, comprised between the notes of said interval. For instance,

- an interval of a second involves two notes of different name like F# and G (demonstrate), or B and C# (demonstrate);
- an interval of a third involves three notes of different name, like from E to G on the D string (demonstrate), or from A to C# on the a string (demonstrate).
- intervals of a fourth, fifth, sixth, and seven involve that number of notes and are performed on more than one string in first position
- an octave is the same note eight notes higher or lower (demonstrate D open and D’ on the A string)
- unison is when two notes of the same name and pitch are played at the same time (demonstrate playing A on the D string, 4th or 2nd fingers, and open A)”

“Half step. A half step is the shortest distance between two notes of different name. In violin or viola playing a half step is achieved by playing with two adjacent fingers together. For instance:

- 1st and 2nd fingers (demonstration: B and C natural on the A string) saying "between B and C natural there is a half step", or

- 2nd and 3rd fingers (demonstrate with F# and G on the D string) saying "between F# and G there is a half step"

"Whole step. It is the distance equivalent to that of two half-steps. In violin or viola playing a whole step is achieved by playing with two adjacent fingers separated. For example:

- 1st and 2nd fingers (demonstration: A and B on the G string), saying "between A and B there is a whole step"
- 2nd and 3rd fingers (demonstration: F natural and G on the D string) saying "between F natural and G there is a whole step.

Tomorrow we will play several intervals that involve half-steps and whole-steps, so that you can apply these concepts into your playing. Thank you."

Day 2

Interval Sheet No. 1 will be given to the students before instruction starts.

"Today we are going to play some intervals in the key of D. This means that you will play F# and C#. Remember that an interval is the distance between two notes, and only as you measure that distance correctly is that you will sound in tune."

“The first six intervals are of a second, which means that they involve two notes of different name. Intervals that have a half step are called minor seconds, intervals that have a whole step are called major seconds.

Let’s start with #1. It is a major second. Listen ... (demonstration) ... now you play!” After students have performed the instructor will continue: “Listen again and adjust your 1st finger accordingly ... (demonstration) ... play!. After students perform second time: “One more time listen and adjust ... (demonstration) ... play!”

Now lets play #2, it is a major second ...

#3 is a minor second ...

#4 is a major second ...

#5 is a major second ...

#6 is a minor second ...

Same demonstration-imitation procedure will be followed for all intervals.

“Now let’s continue. The intervals are of a third which means that there are three notes of different name between the notes of that interval. When intervals of a third involve two whole steps they are called major thirds, when they involve a whole step and a

half step they are called minor thirds.

Lets play #7. It is a minor third. Listen ... (demonstration) ... play!. After students have played the teacher will continue: “Listen and adjust your second finger ... (demonstration) ... play!” After students perform second time teacher will continue: “One more time listen and adjust ... (demonstration) ... play!”

(At this point the students will be familiar with the demonstration-imitation process and instructor may signal with the bow when the students are to play in order to avoid repeating the word ‘play!’ too many times).

#8 is a minor third ...

#9 is a major third ...

#10 is a major third ...

#11 is a minor third ...

#12 is a major third ...

Same demonstration-imitation procedure will be followed for all intervals.

“Now lets play the D major scale in one octave. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!”

Day 3

Today we will play intervals of a fourth, fifth, sixth, and an octave. Fourths and fifths are called perfect, they are not major or minor. Sixths can be major or minor. Octaves do not have any other name.

The first six intervals are of a fourth. Fourths are called perfect, not major or minor. Let's start with #1. Listen ... (demonstration) ... play!

Lets start with #1. It is a perfect fourth. Listen ... (demonstration) ... play!. After students have played the teacher will continue: "Listen and adjust your third finger ... (demonstration) ... play!" After students perform second time teacher will continue: "One more time listen and adjust ... (demonstration) ... play!"

#2 ..., #3 ..., #4 ..., #5 ..., #6 ...

Same procedure will be followed for the rest of the intervals.

Now let's continue. The next three intervals are fifths. Fifths are also called perfect. They are not major or minor.

Let's play #7. It is a perfect fifth. Listen ... (demonstration) ... play!. After students have played the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After students perform second time teacher will continue: "One more time listen and adjust ... (demonstration) ... play!"

#8 is a perfect fifth ...

#9 is also a perfect fifth ...

Now let's play the next two intervals which are sixths. They can be major or minor. A major sixth is played the same as a major second but in two adjacent strings, and a minor sixth is played the same as a minor second but in two adjacent strings.

#10 is a major sixth. Listen ... (demonstration) ... play!. After students have played, the teacher will continue: “Listen and adjust your fingers ... (demonstration) ... play!” After students perform the second time teacher will continue: “One more time listen and adjust ... (demonstration) ... play!”

#11 is a minor sixth ...

And now, let’s play #12 which is an octave.

The same demonstration-imitation procedure will be followed for all intervals.

“Now lets play the D major scale in one octave. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!”

Day 4

Interval Sheet No. 2 must be given to the students before instruction starts.

“Today we are going to play intervals in the key of G major, which has F# and C natural. The first six intervals are of a second, remember that seconds can be major if they involve a whole step, or minor if they involve a half step.

Let’s start with #1. It is a major second. Listen ... (demonstration) ... play! After students have performed the instructor will continue: “Listen again and adjust your 3rd finger accordingly ... (demonstration) ... play!. After students perform second time: "One more time listen and adjust ... (demonstration) ... play!"

Now lets play #2, it is a major second ...

#3 is a minor second ...

#4 is a major second ...

#5 is a major second ...

#6 is a minor second ...

Same demonstration-imitation procedure will be followed for all intervals.

"Now let's continue. The intervals are of a third which means that there are three notes of different name between the notes of the interval. When intervals of a third involve two whole steps they are called major thirds, when they involve a whole step and a half step they are called minor thirds.

Let's play #7. It is a minor third. Listen ... (demonstration) ... play!. After students have played the teacher will continue: "Listen and adjust your second finger ... (demonstration) ... play!" After students perform second time teacher will continue: "One more time listen and adjust ... (demonstration) ... play!"

#8 is a minor third ...

#9 is a major third ...

#10 is a major third ...

#11 is a minor third ...

#12 is a major third ...

Same demonstration-imitation procedure will be followed for all the above intervals.

“Now let’s play the G major scale in one octave. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!”

Day 5

Today we will play intervals of a fourth, fifth, sixth, and an octave in the key of G major. The first six intervals are of a fourth. Remember that fourths are called perfect, not major or minor.

Let’s start with #1. It is a perfect fourth. Listen ... (demonstration) ... play!. After students have played the teacher will continue: “Listen and adjust your third finger ... (demonstration) ... play!” After students perform for the second time teacher will continue: “One more time listen and adjust ... (demonstration) ... play!”

#2 ..., #3 ..., #4 ..., #5 ..., #6 ...

Same procedure will be followed for the rest of the intervals.

Now let’s continue. The next three intervals are fifths. Fifths are also called perfect. They are not major or minor.

Let’s play #7. It is a perfect fifth. Listen ...

(demonstration) ... play!. After students have played the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After students perform second time teacher will continue: "One more time listen and adjust ... (demonstration) ... play!"

#8 is a perfect fifth ...

#9 is also a perfect fifth ...

Now let's play the next two intervals which are sixths. They can be major or minor. A major sixth is played the same as a major second but in two adjacent strings, and a minor sixth is played the same as a minor second but in two adjacent strings.

#10 is a major sixth. Listen ... (demonstration) ... play!. After students have played the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After students perform second time teacher will continue: "One more time listen and adjust your fingers ... (demonstration) ... play!"

#11 is a minor sixth ...

And now let's play #12 which is an octave.

The same demonstration-imitation procedure will be followed for all intervals.

"Now let's play the G major scale in one octave. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!"

Day 6

Interval Sheet No. 3 will be given to the students before instruction starts.

"Today we are going to play some intervals in the key of C, this means that all notes will be natural."

"The first six intervals are of a second, and can be major or minor.

"Let's start with #1. It is a major second. Listen ... (demonstration) ... play!" After students have performed the instructor will continue: "Listen again and adjust your fingers accordingly ... (demonstration) ... play!. After students perform second time teacher will promt: "One more time listen and adjust your fingers ... (demonstration) ... play!"

Now let's play #2, it is a major second ...

#3 is a minor second ...

#4 is a major second ...

#5 is a major second ...

#6 is a minor second ...

Same demonstration-imitation procedure will be followed for all intervals.

"The next six intervals are of a third which means that there are three notes of different name between the notes of the interval. Remember they can be major or minor.

Let's play #7. It is a minor third. Listen ... (demonstration) ... play!." After students have played the teacher will continue: "Listen and adjust your second finger ... (demonstration) ... play!" After students perform second time teacher will continue: "One more time listen and adjust your fingers ... (demonstration) ... play!"

#8 is a minor third ...

#9 is a major third ...

#10 is a major third ...

#11 is a minor third ...

#12 is a major third ...

Same demonstration-imitation procedure will be followed for all intervals.

"Now let's play the C major scale in one octave. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!"

Day 7

"Today we will play intervals of a fourth, fifth, sixth, and an octave in the key of C major. The first six intervals are of a fourth. Remember that fourths are called perfect, not major or minor.

Let's start with #1. It is a perfect fourth. Listen ... (demonstration) ... play!." After students have played the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After students perform for the second time teacher will continue: "One more time listen and adjust your fingers ... (demonstration) ... play!"

#2 ..., #3 ..., #4 ..., #5 ..., #6 ...

Same procedure will be followed for all intervals.

Now let's continue. The next three intervals are fifths. Fifths are also called perfect, not major or minor.

Let's play #7. It is a perfect fifth. Listen ... (demonstration) ... play!. After students have played the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After students perform second time teacher will continue: "One more time listen and adjust ... (demonstration) ... play!"

#8 is a perfect fifth ...

#9 is also a perfect fifth ...

Now let's play the next two intervals which are sixths. They can be major or minor. A major sixth is played the same as a major second but in two adjacent strings, and a minor sixth is played the same as a minor second but in two adjacent strings.

#10 is a major sixth. Listen ... (demonstration) ... play!. After students have played the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After students perform second time teacher will continue: "One more time listen and adjust your fingers ... (demonstration) ... play!"

#11 is a minor sixth ...

And now let’s play #12 which is an octave.

The same demonstration-imitation procedure will be followed for all intervals.

“Now let’s play the C major scale in one octave. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!”

Day 8

Today we are going to play notes that are higher than the octave for violins, as well as some of the notes that we have already played before. We are going to use different kinds of intervals, all in the key of D major.

Let’s start with #1. It is a minor second. Listen ... (demonstration) ... play!. After students have played the teacher will continue: “Listen and adjust your third finger ... (demonstration) ... play!” After students perform the second time teacher will continue: “One more time listen and adjust ... (demonstration) ... play!”

#2 is a major second ...

#3 is a major second ...

#4 is a major third ...

#5 is a minor third ...

#6 is a minor second ...

Let’s continue with #7. It is an octave. Listen ... (demonstration) ... play!. After students have played the teacher will continue: “Listen and adjust your third finger ... (demonstration) ... play!” After students perform second time teacher will continue: “One more time listen and adjust ... (demonstration) ... play!”

#8 is a major third ...

#9 is a minor sixth ...

#10 is a major third ...

#11 is a major second ...

#12 is a minor second ...

The same demonstration-imitation procedure will be followed for all intervals.

“Now let’s play the D major scale. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!”

Day 9

Today we are going to play similar intervals as yesterday but in a different key. We are going to use different kinds of intervals, all in the key of G major.

Let’s start with #1. It is a minor second. Listen ... (demonstration) ... play!. After students have played the teacher will continue: “Listen and adjust your third finger ...

(demonstration) ... play!" After students perform the second time teacher will continue: "One more time listen and adjust ...
(demonstration) ... play!"

#2 is a major second ...

#3 is a major second ...

#4 is a major third ...

#5 is a minor third ...

#6 is a minor second ...

Let's continue with #7. It is an octave. Listen ... (demonstration) ... play!. After students have played the teacher will continue: "Listen and adjust your third finger ... (demonstration) ... play!" After students perform second time teacher will continue: "One more time listen and adjust ... (demonstration) ... play!"

#8 is a major third ...

#9 is a minor sixth ...

#10 is a major third ...

#11 is a major second ...

#12 is a minor second ...

The same demonstration-imitation procedure will be followed for all intervals.

"Now let's play the G major scale. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!”

Day 10

Today we are going to play similar notes as the last two days but in a different key. We will be playing different types of intervals in the key of C major.

Let’s start with #1. It is a minor second. Listen ... (demonstration) ... play!. After students have played the teacher will continue: “Listen and adjust your third finger ... (demonstration) ... play!” After students perform the second time teacher will continue: “One more time listen and adjust ... (demonstration) ... play!”

#2 is a major second ...

#3 is a major second ...

#4 is a major third ...

#5 is a minor third ...

#6 is a minor second ...

Let’s continue with #7. It is an octave. Listen ... (demonstration) ... play!. After students have played the teacher will continue: “Listen and adjust your fingers ... (demonstration) ... play!” After students perform second time teacher will continue: “One more time listen and adjust ... (demonstration) ... play!”

#8 is a major third ...

#9 is a minor sixth ...

#10 is a major third ...

#11 is a major second ...

#12 is a minor second ...

The same demonstration-imitation procedure will be followed for all intervals.

“Now let’s play the C major scale. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!”

Day 11

Today we will play 3-note phrases in the keys of D, G, and C major. All phrases will be composed of two intervals. As before I will play the notes first and then you will play them. Listen carefully and place and adjust your fingers accordingly to play all the notes in tune.

“Let’s start with phrase #1. It is composed of two major seconds. Listen ... (demonstration) ... play!.” After students have played the teacher will continue: “Listen and adjust your third finger ... (demonstration) ... play!” After students perform the second time teacher will continue: “One more time listen and adjust ... (demonstration) ... play!"

Phrase #2 is composed of a major and a minor second ...

... #3 is composed of a major and a minor second ...

... #4 is composed of two major seconds ...

... #5 is composed of a minor sixth and a major second ...

... #6 is composed of a major third and a minor second ...

... #7 is composed of a perfect fourth and a major second ...

... #8 is composed of a perfect fourth and a major second ...

... #9 is composed of a minor third and a major second ...

The same demonstration-imitation procedure will be followed for all intervals. The teacher will remind the students to always listen carefully and to adjust their fingers accordingly to reproduce all the notes they hear as accurately as possible.

"Now let's play the D major scale. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!"

Day 12

Today we are going to play similar 3-note phrases as yesterday, but now in the keys of G, C, and D major. All phrases will be composed of two intervals. As before I will play the notes first and then you will play them. Listen carefully and place and adjust your fingers accordingly to play all the notes in tune.

"Let's start with phrase #1. It is composed of two major seconds. Listen ... (demonstration) ... play!." After students have played the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After students perform the second time teacher will continue: "One more time listen and adjust your fingers ... (demonstration) ... play!"

Phrase #2 is composed of a major and a minor second ...

... #3 is composed of a major and a minor second ...

... #4 is composed of two major seconds ...

... #5 is composed of a minor sixth and a major second ...

... #6 is composed of a major third and a minor second ...

... #7 is composed of a perfect fourth and a major second ...

... #8 is composed of a perfect fourth and a major second ...

... #9 is composed of a minor third and a major second ...

The same demonstration-imitation procedure will be followed for all intervals. The teacher will remind the students to always listen carefully and to adjust their fingers accordingly to reproduce all the notes they hear as accurately as possible.

"Now let's play the G major scale. I will play first then you will play. We will do this only one time. Listen carefully

... (demonstration) ... play!”

Day 13

Today we are going to play the same 3-note phrases but in the keys of C, D, and G major. All phrases will be composed of two intervals. As before I will play the notes first and then you will play them. Listen carefully and place and adjust your fingers accordingly to play all the notes in tune.

“Let’s start with phrase #1. It is composed of two major seconds. Listen ... (demonstration) ... play!.” After students have played the teacher will continue: “Listen and adjust your fingers ... (demonstration) ... play!” After students perform the second time teacher will continue: “One more time listen and adjust your fingers ... (demonstration) ... play!”

Phrase #2 is composed of a major and a minor second ...

... #3 is composed of a major and a minor second ...

... #4 is composed of two major seconds ...

... #5 is composed of a minor sixth and a major second ...

... #6 is composed of a major third and a minor second ...

... #7 is composed of a perfect fourth and a major second ...

... #8 is composed of a perfect fourth and a major second ...

... #9 is composed of a minor third and a major second ...

The same demonstration-imitation procedure will be followed for all intervals. The teacher will remind the students to always listen carefully and to adjust their fingers accordingly to reproduce all the notes they hear as accurately as possible.

"Now let's play the C major scale. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!".

Day 14

Today we are going to play new 3-note phrases in the keys of D, G, and C major. All phrases will be composed of two intervals. As before I will play the notes first and then you will play them. Listen carefully and adjust your fingers accordingly to play all the notes in tune.

"Let's start with phrase #1. It is composed of a major second and a minor third. Listen ... (demonstration) ... play!." After students have played the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After students perform the second time teacher will continue: "One more time listen and adjust your fingers ... (demonstration) ... play!"

Phrase #2 is composed of two minor thirds ...

... #3 is composed of two minor seconds ...

... #4 is composed of a major second and a major third ...

... #5 is composed of two minor thirds ...

... #6 is composed of a minor third and a perfect fourth ...

... #7 is composed of a perfect fourth and a minor third ...

... #8 is composed of a perfect fourth and a minor third ...

... #9 is composed of a major third and a minor second ...

The same demonstration-imitation procedure will be followed for all intervals. The teacher will remind the students to always listen carefully and to adjust their fingers accordingly to reproduce all the notes they hear as accurately as possible.

"Now let's play the D major scale. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!".

Day 15

Today we are going to play similar 3-note phrases as yesterday but in the keys of G, C, and D major. All phrases will be composed of two intervals. As before I will play the notes first and then you will play them. Listen carefully and adjust your fingers accordingly to play all the notes in tune.

"Let's start with phrase #1. It is composed of a major second and a minor third. Listen ... (demonstration) ... play!." After students have played the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After students perform the second time teacher will continue: "One more time listen and adjust your fingers ... (demonstration) ... play!"

Phrase #2 is composed of two minor thirds ...

... #3 is composed of two minor seconds ...

... #4 is composed of a major second and a major third ...

... #5 is composed of two minor thirds ...

... #6 is composed of a minor third and a perfect fourth ...

... #7 is composed of a perfect fourth and a minor third ...

... #8 is composed of a perfect fourth and a minor third ...

... #9 is composed of a major third and a minor second ...

The same demonstration-imitation procedure will be followed for all intervals. The teacher will remind the students to always listen carefully and to adjust their fingers accordingly to reproduce all the notes they hear as accurately as possible.

"Now let's play the G major scale. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!".

Day 16

Today we are going to play similar 3-note phrases as yesterday but in the keys of C, D, and G major. All phrases are composed of two intervals. As before I will play the notes first and then you will play them. Listen carefully and adjust your fingers accordingly to play all the notes in tune.

"Let's start with phrase #1. It is composed of a major second and a minor third. Listen ... (demonstration) ... play!." After students have played the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After students perform the second time teacher will continue: "One more time listen and adjust your fingers ... (demonstration) ... play!"

Phrase #2 is composed of two minor thirds ...

... #3 is composed of two minor seconds ...

... #4 is composed of a major second and a major third ...

... #5 is composed of two minor thirds ...

... #6 is composed of a minor third and a perfect fourth ...

... #7 is composed of a perfect fourth and a minor third ...

... #8 is composed of a perfect fourth and a minor third ...

... #9 is composed of a major third and a minor second ...

The same demonstration-imitation procedure will be followed for all intervals. The teacher will remind the students to always listen carefully and to adjust their fingers accordingly to reproduce all the notes they hear as accurately as possible.

"Now let's play the C major scale. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!”.

Day 17

Today we will play 4-note phrases. They are written in the keys of D, G, and C major, but not necessarily in that order. All phrases are composed of three intervals. As before I will play the notes first and then you will play them. Listen carefully and place and adjust your fingers accordingly to play all the notes in tune.

“Let’s start with phrase #1. It is composed of a minor third, a perfect fourth, and a minor sixth. Listen ... (demonstration) ... play!.” After the students play the teacher will continue: “Listen and adjust your fingers ... (demonstration) ... play!” After the students perform the second time the teacher will continue: “One more time listen and adjust your fingers ... (demonstration) ... play!”

Phrase #2 is composed of a perfect fourth, a major second, and a minor third ...

... #3 is composed of two minor thirds, and a major third ...

... #4 is composed of a minor second, a major second, and a perfect fourth ...

... #5 is composed of a perfect fourth and two minor seconds

... #6 is composed of a minor third, a major sixth, and a minor second ...

The same demonstration-imitation procedure will be followed for all intervals. The teacher will remind the students to always listen carefully and to adjust their fingers accordingly to
reproduce all the notes they hear as accurately as possible.

"Now let's play the D major scale. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!".

Day 18

Today we will continue playing 4-note phrases in the keys of D, G, and C major but not necessarily in that order. All phrases are composed of three intervals. As before I will play the notes first and then you will play them. Listen carefully and place and adjust your fingers accordingly to play all the notes in tune.

"Let's start with phrase #1. It is composed of a minor third and two minor seconds. Listen ... (demonstration) ...

play!." After the students play the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After the

students perform the second time the teacher will continue: "One more time listen and adjust your fingers ... (demonstration) ... play!"

Phrase #2 is composed of a minor second and two major

seconds

... #3 is composed of three minor thirds ...

... #4 is composed of two major thirds and a minor third ...

... #5 is composed of a minor second and two major seconds

... #6 is composed of a minor sixth, a minor third, and a perfect fifth ...

The same demonstration-imitation procedure will be followed for all intervals. The teacher will remind the students to always listen carefully and to adjust their fingers accordingly to reproduce all the notes they hear as accurately as possible.

"Now let's play the G major scale. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!".

Day 19

Today we will play more 4-note phrases in the keys of D, G, and C major. All phrases are composed of three intervals. As before I will play the notes first and then you will play them. Listen carefully and place and adjust your fingers accordingly to play all the notes in tune.

"Let's start with phrase #1. It is composed of a major third, and two minor seconds. Listen ... (demonstration) ... play!." After the students play the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After the students perform the second time the teacher will continue: "One more time listen and adjust your fingers ... (demonstration) ... play!"

Phrase #2 is composed of a perfect fourth, and two major seconds ...

... #3 is composed of a minor sixth, a minor third, and a minor second ...

... #4 is composed of a major third, a minor sixth, and a minor third ...

... #5 is composed of a minor third, a major second, and a minor second ...

... #6 is composed of a minor third, a major second, and a major third ...

The same demonstration-imitation procedure will be followed for all intervals. The teacher will remind the students to always listen carefully and to adjust their fingers accordingly to reproduce all the notes they hear as accurately as possible.

"Now let's play the C major scale. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!".

Day 20

Today we will continue playing 4-note phrases in the keys of D, G, and C major. All phrases are composed of three intervals. As before I will play the notes first and then you will play them. Listen carefully and place and adjust your fingers accordingly to play all the notes in tune.

"Let's start with phrase #1. It is composed of a major third, a minor third, and a major second. Listen ... (demonstration) ... play!." After the students play the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After the students perform the second time the teacher will continue: "One more time listen and adjust your fingers ... (demonstration) ... play!"

Phrase #2 is composed of a minor third, and two minor seconds ...

... #3 is composed of a minor sixth, a minor second, and a minor third ...

... #4 is composed of a perfect fourth, a major second, and a minor third ...

... #5 is composed of a perfect fourth and two major seconds ...

... #6 is composed of a perfect fourth and two minor seconds ...

The same demonstration-imitation procedure will be followed for all intervals. The teacher will remind the students to always listen carefully and to adjust their fingers accordingly to reproduce all the notes they hear as accurately as possible.

"Now let's play all the three major scales. I will play them first, then you will play. Each scale will be played only one time.

let's start with D major ... listen carefully ... (demonstration) ... play!".

now let's play G major ... listen carefully ... (demonstration) ... play!".

and now C major ... listen carefully ... (demonstration) ... play!".

APPENDIX D

TEACHER MANUAL
AURAL/VISUAL METHODOLOGY

TEACHER MANUAL
AURAL/VISUAL METHODOLOGY

PART I
INTRODUCTION

TEACHER MANUAL

AURAL-VISUAL METHODOLOGY

Introduction

The aural-visual methodology will encompass the training of pitch discrimination and the attainment of improved performed intonation from an aural (listening), and visual (seeing) approach. Subjects will be given a pre-instructional test to determine the level of each student's intonational accuracy, and a post-instructional test to assess the students' performed intonation improvement, if any.

The treatment will be implemented during twenty days and will last **only** ten minutes of each class period. It will encompass specific instructional strategies designed to give the string player a better understanding of pitch relationships and left hand finger placement, and how these affect the accuracy of intonation. At the end of the ten-minute instructional time the instructor will **stop** all instructional activities.

Verbal Communication

Verbal communication will be the means by which the instructor will convey or explain to the students:

(a) concepts involved in performed intonation: i.e. interval distances

(b) procedural directives as outlined in the instructional steps.

Sequence of activities.

The activities for each day of instruction will be delineated
in a detailed manner in the **Daily Instructional Activities** section of this manual.

Tuning

Students' instruments will be tuned on a daily basis to A-440. The electronic instrument used will reproduce an audible sound of said note so that all students can hear it and can develop an aural recognition of that pitch.

The tuning process, however long it may be, will not be counted as part of the ten minute instructional time.

Materials

The researcher will provide the materials for the students (interval sheets) to be used daily during the instructional time. Keys are established by means of accidentals, since this is the manner in which the music tasks are written.

The Aural/Visual Methodology Instructor **MAY NOT:**

Add any accidentals to create more or new intervals. For the purposes of this research the intervals used will be those comprised in the keys of D, G, and C major.

AURAL INSTRUCTIONAL PROCEDURES

Teacher Modeling

Teacher modeling will be the pedagogical tool used in the aural aspect of the intonation training. The modeling of pitches by the instructor will encompass:

(a) the performance of notes with accurate intonation, and

(b) the imitation of the students aiming to reproduce the notes as close as possible as they heard them.

Procedures for the **teacher modeling-student imitation** cycle.

(a) The teacher will use a violin or a viola to model the production of notes with correct intonation.

(b) Students will listen discriminately and will reproduce as accurately as possible the pitches they heard.

(c) The teacher modeling-student imitation cycle (a complete set) will be repeated three times for each interval addressed.

(d) There will be no feedback from the instructor to the students as to how well or poorly they are performing.

Instructional Procedures

The following steps are involved in the instructional phase of this research:

(1) **Introduction of concepts.** The explanation of the concepts involved in intonation will be done on the first day of the instructional phase, and will be applied and reiterated thereafter, during the instructional activities.

(2) **Teacher modeling:** this involves a performance-demonstration

(3) **Students' imitation** response. This will comprise two actions:

(a) **listening** as the teacher performs,

(b) **looking (observing)** the visual aid (fingerboard) during the teacher demonstration, and

(c) **reproducing** the pitches performed by the instructor

<u>I. Introduction of concepts.</u>

Teacher will explain the following concepts on the first day of the instructional period:

- Intonation
- Intervals
- Whole step
- Half step

Please refer to the **Daily Instructional Activities** for an step-by-step description of concepts presentation. This also contains the implementation sequence of the activities of this intonation training.

II. Teacher modeling or performance-demonstration.

After concepts have been clearly explained to the students the teacher will proceed to apply them in the aural aspect of the intonation training.

(1) The teacher will address the students verbally implementing all procedures according to the Daily Instructional Activities

(2) Teacher will get ready for the performance-demonstration, and will produce a clear tone at a forte dynamic level.

(3) After the teacher modeling-performance the students will reproduce the notes they heard.

(4) Instructor will remind the students the key they are performing in.

(5) Each interval will be repeated three times. Between trials of the same interval the teacher will remind students to:

(a) **listen** to the:

- performed pitches
- pitches they are producing, and

(b) **adjust** their fingers as they play, if needed, to play each pitch in tune.

(6) Teacher will perform **once** a one-octave scale each day at the end of the instructional time, students will imitate in the same manner as they did with the intervals.

III. Students' response.

Prior to the teacher modeling students will be asked:

(a) to **listen** to the pitches performed by the instructor

(b) to **look** at the dots on the fingerboard (visual aid) representing finger placement as the teacher performs, and

(c) to **reproduce**, as accurately as possible, the pitches they hear and see when the instructor gives the command.

VISUAL METHODOLOGY

The visual aspect of intonation training will involve the use of a visual aid consisting of a two-dimensional representation of a violin or viola fingerboard. It will include movable dots to be positioned in the finger placement spots on the strings. Dots will be of three different colors: green to represent natural notes, yellow to symbolize sharped notes, and blue to depict flatted notes.

Use of Visual Aid

(1) Use of visual aid (instrument fingerboard and finger placement dots)

Teacher will place the dots on the strings of the fingerboard in the visual aid to illustrate interval distances within one or more strings.

(2) To make the transition from a two-dimensional figure to a three-dimensional situation the instructor will give a silent physical demonstration of finger placement in a violin or viola (nonverbal modeling), for the students to see the correct placement of left hand fingers.

VISUAL INSTRUCTIONAL PROCEDURES

The activities involved in this instructional methodology will encompass:

- verbal explanations of concepts
- use of visual aid showing the pitch location points on the strings

Visual activities

The main purpose for using a visual aid: a fingerboard with movable dots, is to determine with exactness the location of pitches on the strings, and visually demonstrate this to the students. It includes:

- Green dots to indicate all natural notes
- Yellow dots to represent notes altered by sharps
- Blue dots to reflect notes altered by flats

Teacher will place the dots on visual aid before the modeling performance of an interval.

Implementation of Visual Instructional Activities

(1) When the instructor announces to the students what interval he is going to model he will also **place** the corresponding dots on the strings of the visual aid.

(2) He will then ask the students to:

a. **listen** to the performed pitches, and

b. **look** at the visual aid to have a correct visual conception of finger placement on the strings as it applies to half- and whole-steps.

(3) This procedure will be followed with all intervals as they are modeled by the teacher and imitated by the students.

(4) When a one-octave scale is performed the dots representing the degrees of the scale will have been placed ahead of time on one of the fingerboards provided for the study.

Instructional Material

(a) The intervals to be performed will be in the keys of D, G, and C. The intervals involved are:

- major and minor seconds
- major and minor thirds
- perfect fourths and fifths
- major and minor sixths
- octaves

(b) The intervals used will be those comprised in those keys, and are playable in first position.

Expectations

At the end of the instructional period it is hoped that :
(1) students will be familiar with the following concepts and terminology:

(a) Intonation

(b) Interval - the distance between two notes

(c) Half step - shortest distance possible between two notes

(d) Whole step - distance equal to two half steps
clear understanding of accidentals: sharps, flats, naturals.

(e) Dynamics: mf (mezzo forte), f (forte)

(2) students will understand and demonstrate proficiency performing the following intervals in the keys of D, G, and C:

(a) major and minor seconds (on the same string)

(b) major and minor thirds (on one or two strings)

(c) perfect fourths (on one or two strings)

(d) perfect fifths (on two strings)

(e) major seventh (leading tone)

(f) octave (open string and 3rd finger on two adjacent strings, 3rd and 2nd fingers on two non-adjacent strings)

TEACHER MANUAL
AURAL/VISUAL METHODOLOGY

PART II
DAILY INSTRUCTIONAL ACTIVITIES

AURAL-VISUAL METHODOLOGY
DAILY INSTRUCTIONAL ACTIVITIES

Day 1

Presentation of concepts. The instructor will present to the students four basic concepts necessary in the teaching of intonation explaining them verbally and using a visual aid to illustrate and further clarify these concepts in the following manner:

"Today we are going to learn more about playing with correct intonation. I will be using a visual aid that is the representation of an instrument fingerboard with movable dots to show you where your fingers should be placed. The green dots will represent natural notes, the yellow dots will represent notes altered by a sharp, and blue dots will represent notes altered by a flat.

There are four basic concepts involved in playing with accurate intonation.

First let's define what is intonation. Intonation, or playing in tune, is the production of musical notes according to a pitch model or standard.

(a) "If a note is played above the standard it is considered high or sharp and consequently not in tune". (Demonstrate playing E on the D string.)

- first play it with correct pitch saying "here is the standard” and show it with a green dot on the D string

- then play it sharp and say “this is too sharp and consequently out of tune”, and move the dot accordingly
- before playing it back in pitch say “To correct that note I need to adjust my first finger so I can play it according to the standard” and perform it with correct pitch, and move the dot back to its correct position.

(b) “If a note is played below the standard it is low or flat and also is not in tune.” Place the dot in the correct place. Demonstrate placing a green dot on the D on the A string and then performing it.

- first play it with correct pitch saying “here is the standard” and putting the dot in the correct place
- then make it flat saying “this is too low and out of tune” move the dot back
- then bring it back to pitch saying “To correct that note I need to adjust my third finger so I can play it according to the standard” move the dot back to its correct place

(c) Playing in tune then means that each note be accurately reproduced according to the standard.

To achieve this first you must listen to the standard and look at the visual aid very carefully, in order to:

(1) know what the pitch sounds like

(2) place in your mind a pitch that you can aim for then you

play

(3) have a correct visual conception of where your fingers should be placed (how close or separated)) to reproduce those notes.

If you aim too high you must then adjust your fingers to bring the pitch lower as I did it when I play that E too sharp; and if you aim to low you need to adjust your fingers to bring the pitch higher, as I did it when I played that D too low."

"Interval. It is the distance between two notes. An interval takes its name according to the number of notes, of different name, comprised between the notes of said interval. For instance,

- an interval of a second involves two notes of different name like F# and G (demonstrate), or B and C# (demonstrate); place dots on visual aid to show those notes
- an interval of a third involves three notes of different name, like from E to G on the D string (demonstrate and show it on the visual aid), or from A to C# on the a string (demonstrate and show).
- intervals of a fourth, fifth, sixth, and seven involve that number of notes and are performed on more than one string in first position
- an octave is the same note eight notes higher or lower (demonstrate D open and D' on the A string and show it)

- unison is when two notes of the same name and pitch are played at the same time (demonstrate playing A on the D string, 4th or 2nd fingers, and open A)"

"<u>Half step.</u> A half step is the shortest distance between two notes of different name. In violin or viola playing a half step is achieved by playing with two adjacent fingers together. For instance:

- 1st and 2nd fingers (demonstration: B and C natural on the A string) saying "between B and CII there is a half step", (show) or
- 2nd and 3rd fingers (demonstrate with F# and G on the D string) saying "between F# and G there is a half step" (show)

"<u>Whole step.</u> It is the distance equivalent to that of two half-steps. In violin or viola playing a whole step is achieved by playing with two adjacent fingers separated.
For example:

- 1st and 2nd fingers (demonstration: A and B on the G string), saying "between
A and B there is a whole step" (show)
- 2nd and 3rd fingers (demonstration: F natural and G on the D string) saying "between F natural and G there is a whole step" (show).

Tomorrow we'll play several intervals involving half-steps and whole-steps so that you can apply these concepts to your playing. Thank you."

Day 2

Interval Sheet No. 1 will be given to the students before instruction starts.

"Today we are going to play some intervals in the key of D. This means that F and C are sharp . Remember that an interval is the distance between two notes, and only as you measure that distance correctly is that you will sound in tune.

Some intervals are of a second, which means that they involve two notes of different name. Intervals that have a half step are called minor seconds, intervals that have a whole step are called major seconds.

Let's start with #1. It is a major second. Look and listen ... (place dots on visual aid and demonstrate) ... play! After students have performed the instructor will continue: "Listen and Look at the fingerboard again and adjust your 1st finger accordingly ... (point at visual aid and demonstrate) ... play!." After students perform second time teacher will say: "One more time listen, look, and adjust ... (demonstration) ... play!"

Now lets play #2, it is a major second ...

#3 is a minor second ...

#4 is a major second ...

#5 is a major second ...

#6 is a minor second ..."

"Now, let's continue. The intervals are of a third which means that there are three notes of different name between the notes of the interval. When intervals of a third involve two whole steps they are called major thirds, when they involve a whole step and a half step they are called minor thirds.

Let's play #7. It is a minor third. Look and listen ... (place dots on visual aid and demonstrate) ... play!" After students have performed the instructor will continue:

"Listen and look again and adjust your 1st finger accordingly ... (point at visual aid and demonstrate) ... play!. After students perform second time teacher will say: "One more time listen, look, and adjust ... (demonstration) ... play!"

(At this point the students will be familiar with the demonstration-imitation process that instructor may signal with the bow when the students are to play in order to avoid repeating the word 'play' too many times).

#8 is a minor third ...

#9 is a major third ...

#10 is a major third ...

#11 is a minor third ...

#12 is a major third ..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now, lets play the D major scale in one octave. I will play it first then you will play. We will do this only one time. Look and listen carefully ... (point to dots on visual aid and demonstrate) ... play!"

Day 3

"Today we will play intervals of a fourth, fifth, sixth, and an octave. Fourths and fifths are called perfect, they are not major or minor. Sixths can be major or minor.
Octaves do not have any other name.

The intervals in line C are intervals of a fourth. Remember, fourths are called perfect, not major or minor. Let's start with #1. Listen ... (demonstration) ... play!

Let's start with #1. It is a perfect fourth. Look and listen ... (place dots on visual aid and demonstrate) ... play!"
After students have performed the instructor will continue:
"Listen and look again and adjust your 1st finger accordingly ... (point to fingerboard and demonstrate) ... play!. After students perform second time teacher will say: "One more time listen, look, and adjust ... (demonstration) ... play!

#2 ..., #3 ..., #4 ..., #5 ..., #6 ...

Let's continue. The next three intervals are fifths.

Fifths are also called perfect. They are not major or minor.

Let's play #7. It is a perfect fifth. Look and listen ... (place dots on visual aid and demonstrate) ... play!. After students have played the teacher will continue: "Listen and look again and adjust your fingers ... (point at the visual aid and demonstrate) ... play!" After students perform second time teacher will continue: "One more time listen, look and adjust ... (demonstration) ... play!"

#8 is a perfect fifth ...

#9 is also a perfect fifth ...

Now let's play the next two intervals which are sixths. They can be major or minor. A major sixth is played the same as a major second but in two adjacent strings, and a minor sixth is played the same as a minor second but in two adjacent strings.

Let's play #10. It is a major sixth. Look and listen ... (place dots on visual aid and demonstrate) ... play!. After students have played the teacher will continue: "Listen, look and adjust your fingers ... (point to the visual aid and demonstrate) ... play!" After students perform second time teacher will continue: "One more time listen, look and adjust ... (demonstration) ... play!"

#11 is a minor sixth ...

And now let's play #12, it is an octave (show and demonstrate).

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now, let's play the D major scale in one octave. I will play first then you will play. We will do this only one time. Look and listen carefully ... (point to dots on visual aid and demonstrate) ... play!"

Day 4

Interval Sheet No. 2 will be given to the students before instruction starts.

"Today we are going to play intervals in the key of G major, which involves F# and C natural. In line A the intervals are of a second, remember that seconds can be major if they involve a whole step or minor if they involve a half step.

Let's start with #1. It is a major second. Look and listen ... (place dots on visual aid and demonstrate) ... play! After students have performed the instructor will continue: "Listen and look again and adjust your 1st finger accordingly ... (point to fingerboard and demonstrate) ... play!. After students perform second time teacher will say: "One more time listen, look, and adjust ... (demonstration) ... play!"

Now lets play #2, it is a major second ...

#3 is a minor second ...

#4 is a major second ...

#5 is a major second ...

#6 is a minor second ...

"Now let's continue. The intervals that follow are of a third which means that there are three notes of different name between the notes of the interval. When intervals of a third involve two whole steps they are called major thirds, when they involve a whole step and a half step they are called minor thirds.

Let's play #7. It is a major third. Look and listen ... (place dots on visual aid and demonstrate) ... play!" After students have performed the instructor will continue: "Listen and look again and adjust your 1st finger accordingly ... (point to fingerboard and demonstrate) ... play!." After students perform second time teacher will
say: "One more time listen, look, and adjust ... (demonstration) ... play!

#8 is a minor third ...

#9 is a minor third ...

#4 is a major third ...

#5 is a major third ...

#6 is a minor third ...

#7 is a major third ..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now, let's play the G major scale in one octave. I will play first then you will play. We will do this only one time. Look and listen carefully ... (point to dots on visual aid and demonstrate) ... play!"

Day 5

"Today we will play intervals of a fourth, fifth, sixth, and an octave in the key of G major. Remember that fourths are called perfect, not major or minor.

Let's start with #1. It is a perfect fourth. Look and listen ... (place dots on visual aid and demonstrate) ... play! After students have performed the instructor will continue: "Listen and look again and adjust your fingers accordingly ... (point to visual aid and demonstrate) ... play!. After students perform second time teacher will say: "One more time listen, look, and adjust ... (demonstration) ... play!

#2 ..., #3 ..., #4 ..., #5 ..., #6 ...

"Now let's continue. The next three intervals are fifths. Fifths are also called perfect. They are not major or minor.

Let's play #7. It is a perfect fifth. Look and listen ... (place dots on visual aid and demonstrate) ... play!. After students have played the teacher will continue: "Listen, look and adjust your fingers ... (point at the visual aid and demonstrate) ... play!" After students perform second time teacher will continue: "One more time listen, look and adjust ... (demonstration) ... play!"

#8 is a perfect fifth ...

#9 is also a perfect fifth ...

Now let's play the next two intervals which are sixths. They can be major or minor. A major sixth is played the same as a major second but in two adjacent strings, and a minor sixth is played the same as a minor second but in two adjacent strings.

#10 is a major sixth. Look and listen ... (place dots on visual aid and demonstrate) ... play!. After students have played the teacher will continue: "Look, listen and adjust your fingers ... (point at visual aid and demonstrate) ... play!" After students perform second time teacher will continue: "One more time listen, look and adjust ... (demonstration) ... play!"

#11 is a minor sixth

And now, let's play #12 which is an octave."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now, let's play the G major scale in one octave. I will play first then you will play. We will do this only one time.

Look and listen carefully ... (point to dots on visual and demonstrate) ... play!"

Day 6

"Today we are going to play some intervals in the key of C, this means that all notes will be natural. The first six intervals are of a second, and can be major or minor. Let's start with #1. It is a major second. Look and listen ... (place dots on visual aid and demonstrate) ... play!" After students have performed the instructor will continue: "Listen again and adjust your fingers accordingly ... (demonstration) ... play!." After students perform second time teacher will prompt: "One more time look, listen and adjust your fingers ... (demonstration) ... play!

Now let's play #2, it is a major second ...

#3 is a minor second ...

#4 is a major second ...

#5 is a major second ...

#6 is a minor second ..."

The next six intervals are of a third, which means that there are three notes of different name between the notes of the interval. Remember they can be major or minor.

Let's play #7. It is a minor third. Look and listen ... (place dots on visual aid and demonstrate) ... play!" After students have performed the instructor will continue: "Listen and look again and adjust your fingers accordingly ... (point to visual aid and demonstrate) ... play!. After students perform second time teacher will say: "One more time look, listen, and adjust your fingers ... (demonstration) ... play!

#8 is a minor third ...

#9 is a major third ...

#10 is a major third ...

#11 is a minor third ...

#12 is a major third ..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now, let's play the C major scale in one octave. I will play first then you will play. We'll do this only one time. Look and listen carefully ... (demonstration) ... play!"

Day 7

"Today we will play intervals of a fourth, fifth, sixth, and an octave in the key of C major. The first six intervals are of a fourth. Remember that fourths are called perfect, not major or minor.

Let's start with #1. It is a perfect fourth. Look and listen ... (place dots on visual aid and demonstrate) ... play!"

After students have performed the instructor will continue: "Listen and look again and adjust your fingers accordingly ... (point to visual aid and demonstrate) ... play!. After students perform second time teacher will say: "One more time listen, look, and adjust ... (demonstration) ... play!

#2 ..., #3 ..., #4 ..., #5 ..., #6 ...

Now let's continue. The next three intervals are fifths. Fifths are also called perfect, not major or minor.

Let's play #7. It is a perfect fifth. Look and listen ... (demonstration) ... play!." After students have played the teacher will continue: "Again look, listen, and adjust your fingers ... (demonstration) ... play!" After students perform second time teacher will continue: "One more time look, listen and adjust ... (demonstration) ... play!

#8 is a perfect fifth ...

#9 is also a perfect fifth ...

Now let's play the next two intervals which are sixths. They can be major or minor. A major sixth is played the same as a

major second but in two adjacent strings, and a minor sixth is played the same as a minor second but in two adjacent strings.

#10 is a major sixth. Listen ... (demonstration) ... play!." After students have played the teacher will continue: "Listen and adjust your fingers ... (demonstration) ... play!" After students perform second time teacher will continue: "One more time listen and adjust your fingers ... (demonstration) ... play!

#11 is a minor sixth ...

Let's play #12 which is an octave..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now, let's play the C major scale in one octave. I will play first then you will play. We will do this only one time. Look and listen carefully ... (demonstration) ... play!"

Day 8

"Today we are going to play notes that are higher than the octave for violins, as well as some of the notes that we have already played before. We are going to use different kinds of intervals, all in the key of D major.

Let's start with #1. It is minor second. Look and listen ... (place dots on visual aid and demonstrate) ... play!. " After students have played the teacher will continue: "Look, listen and adjust your fingers ... (point to the visual aid and demonstrate) ... play!" After students perform the second time teacher will continue: "One more time look, listen, and adjust your fingers ... (demonstration) ... play!

#2 is a major second ...

#3 is a major second ...

#4 is a major third ...

#5 is a minor third ...

#6 is a minor second ...

Let's continue with #7. It is an octave. Look and listen ... (place dots on the visual aid and demonstrate) ... play!. After students have played the teacher will continue: "Look, listen and adjust your fingers ... (point to the visual aid and demonstrate) ... play!" After students perform second time teacher will continue: "One more time look, listen, and adjust your fingers ... (demonstration) ... play!

#8 is a major third ...

#9 is a minor sixth ...

#10 is a major third ...

#11 is a major second ...

#12 is a minor second ..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now, let's play the D major scale. I will play first then you will play. We will do this only one time. Look and listen carefully ... (demonstration) ... play!”

Day 9

“Today we are going to play similar intervals as yesterday but in a different key. We are going to use different kinds of intervals, all in the key of G major.

Let’s start with #1. It is minor second. Look and listen ... (place dots on visual aid and demonstrate) ... play!.” After students have played the teacher will continue: “Listen and adjust your third finger ... (point to the visual aid and demonstrate) ... play!” After students perform the second time teacher will continue: “One more time look, listen, and adjust your fingers ... (demonstration) ... play!

#2 is a major second ...

#3 is a major second ...

#4 is a major third ...

#5 is a minor third ...

#6 is a minor second ...

Let’s continue with #7. It is an octave. Look and listen ... (place dots on the visual aid and demonstrate) ... play!. After students have played the teacher will continue: “Look, listen and adjust your fingers ... (point to the visual aid and demonstrate) ... play!” After students perform second time teacher will continue: “One more time look, listen, and adjust your fingers ... (demonstration) ... play!

#8 is a major third ...

#9 is a minor sixth ...

#10 is a major third ...

#11 is a major second ...

#12 is a minor second ..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now, let's play the G major scale. I will play first then you will play. We will do this only one time. Look and listen carefully ... (demonstration) ... play!"

Day 10

"Today we are going to play similar notes as the last two days but in a different key. We will be playing different types of intervals in the key of C major.

Let's start with #1. It is minor second. Look and listen ... (place dots on visual aid and demonstrate) ... play!. After students have played the teacher will continue: "Look, listen and adjust your fingers ... (point to the visual aid and demonstrate) ... play!" After students perform the second time teacher will continue: "One more time look, listen, and adjust your fingers ... (demonstration) ... play!

#2 is a major second ...

#3 is a major second ...

#4 is a major third ...

#5 is a minor third ...

#6 is a minor second ...

Let's continue with #7. It is an octave. Look and listen ... (place dots on the visual aid and demonstrate) ... play!. After students have played the teacher will continue: "Look, listen and adjust your fingers ... (point to the visual aid and demonstrate) ... play!" After students perform second time teacher will continue: "One more time look, listen, and adjust your fingers ... (demonstration) ... play!

#8 is a major third ...

#9 is a minor sixth ...

#10 is a major third ...

#11 is a major second ...

#12 is a minor second ..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now, let's play the G major scale. I will play first then you will play. We will do this only one time. Listen carefully ... (demonstration) ... play!".

Day 11

"Today we will play 3-note phrases in the keys of D, G, and C major. All phrases will be composed of two intervals. As before I will play the notes first and then you will play them. Look and listen carefully and adjust your fingers accordingly to play all the notes in tune.

Let's start with phrase #1. It is composed of two major seconds. Look and listen ... (place dots on the visual aid and demonstrate) ... play!." After students have played the teacher will continue: "Look, listen and adjust your fingers ... (demonstration) ... play!" After students perform the second time teacher will continue: "One more time look, listen, and adjust your fingers ... (demonstration) ... play!

Phrase #2 is composed of a major and a minor second ...

... #3 is composed of a major and a minor second ...

... #4 is composed of two major seconds ...

... #5 is composed of a minor sixth and a major second ...

... #6 is composed of a major third and a minor second ...

... #7 is composed of a perfect fourth and a major second ...

... #8 is composed of a perfect fourth and a major second ...

... #9 is composed of a minor third and a major second ..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to listen carefully and to adjust their fingers accordingly to reproduce as accurately as possible all the notes they hear.

"Now, let's play the D major scale. I will play first then you will play. We will do this only one time. Look and listen carefully ... (demonstration) ... play!".

Day 12

"Today we are going to play similar 3-note phrases as yesterday but in the keys of G, C, and D major. All phrases will be composed of two intervals. As before I will play the notes first and then you will play them. Look and listen carefully and adjust your fingers accordingly to play all the notes in tune.

Let’s start with phrase #1. It is composed of two major seconds. Look and listen ... (place dots on the visual aid and demonstrate) ... play!.” After students have played the teacher will continue: “Look, listen and adjust your fingers ... (demonstration) ... play!” After students perform the second time teacher will continue: “One more time look, listen, and adjust your fingers ... (demonstration) ... play!

Phrase #2 is composed of a major and a minor second ...

... #3 is composed of a major and a minor second ...

... #4 is composed of two major seconds ...

... #5 is composed of a minor sixth and a major second ...

... #6 is composed of a major third and a minor second ...

... #7 is composed of a perfect fourth and a major second ...

... #8 is composed of a perfect fourth and a major second ...

... #9 is composed of a minor third and a major second ...”

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce as accurately as possible all the notes they hear.

“Now, let’s play the G major scale. I will play first then you will play. We will do this only one time. Look and listen carefully ... (demonstration) ... play!”.

Day 13

"Today we are going to play the same 3-note phrases as before but now in the keys of C, D, and G major. All phrases will be composed of two intervals. I will play the notes first and then you will play them. Look and listen carefully and adjust your fingers accordingly to play all the notes in tune.

Let's start with phrase #1. It is composed of two major seconds. Look and listen ... (place dots on the visual aid and demonstrate) ... play!." After students have played the teacher will continue: "Look, listen and adjust your fingers ... (demonstration) ... play!" After students perform the second time teacher will continue: "One more time look, listen, and adjust your fingers ... (demonstration) ... play!

Phrase #2 is composed of a major and a minor second ...

... #3 is composed of a major and a minor second ...

... #4 is composed of two major seconds ...

... #5 is composed of a minor sixth and a major second ...

... #6 is composed of a major third and a minor second ...

... #7 is composed of a perfect fourth and a major second ...

... #8 is composed of a perfect fourth and a major second ...

... #9 is composed of a minor third and a major second ...”

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce as accurately as possible all the notes they hear.

“Now, let’s play the C major scale. I will play first then you will play. We will do this only one time. Look and listen carefully ... (demonstration) ... play!”.

Day 14

“Today we are going to play new 3-note phrases in the keys of D, G, and C major. All phrases will be composed of two intervals. As before I will play the notes first and then you will play them. Look and listen carefully, and adjust your fingers accordingly to
play all the notes in tune.

Let’s start with phrase #1. It is composed of a major second and a minor third. Look and listen ... (place dots on the visual aid and demonstrate) ... play!.” After the students play the teacher will continue: “Look, listen and adjust your fingers ... (demonstration) ... play!” After students perform the second time the teacher will continue: “One more time look, listen and adjust your fingers ... (demonstration) ... play!

Phrase #2 is composed of two minor thirds ...

... #3 is composed of two minor seconds ...

... #4 is composed of a major second and a major third ...

... #5 is composed of two minor thirds ...

... #6 is composed of a minor third and a perfect fourth ...

... #7 is composed of a perfect fourth and a minor third ...

... #8 is composed of a perfect fourth and a minor third ...

... #9 is composed of a major third and a minor second ..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now, let's play the D major scale. I will play first then you will play. We will do this only one time. Look and listen ... (demonstration) ... play!".

Day 15

"Today we are going to play similar 3-note phrases as yesterday but in the keys of G, C, and D major. All phrases will be composed of two intervals. As before, I will play the notes first and then you will play them. Look and listen carefully, and adjust your fingers accordingly to play all the notes in tune.

Let's start with phrase #1. It is composed of a major second and a minor third. Look and listen ... (place dots on the visual aid and demonstrate) ... play!." After the students play the teacher will continue: "Look, listen and adjust your fingers ... (demonstration) ... play!" After the students perform the second time the teacher will continue: "One more time look, listen and adjust your fingers ... (demonstration) ... play!

Phrase #2 is composed of two minor thirds ...

... #3 is composed of two minor seconds ...

... #4 is composed of a major second and a major third ...

... #5 is composed of two minor thirds ...

... #6 is composed of a minor third and a perfect fourth ...

... #7 is composed of a perfect fourth and a minor third ...

... #8 is composed of a perfect fourth and a minor third ...

... #9 is composed of a major third and a minor second ..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now, let's play the G major scale. I will play first then you will play. We will do this only one time. Look and listen ... (demonstration) ... play!".

Day 16

“Today we are going to play similar 3-note phrases as yesterday but in the keys of C, D, and G major. All phrases are composed of two intervals. As before I will play the notes first and then you will play them. Look and listen carefully, and adjust your fingers accordingly to play all the notes in tune.

Let’s start with phrase #1. It is composed of a major second and a minor third. Look and listen ... (place dots on the visual aid and demonstrate) ... play!.” After the students play the teacher will continue: “Look, listen and adjust your fingers ... (demonstration) ... play!” After the students perform the second time the teacher will continue: “One more time look, listen and adjust your fingers ... (demonstration) ... play!

Phrase #2 is composed of two minor thirds ...

... #3 is composed of two minor seconds ...

... #4 is composed of a major second and a major third ...

... #5 is composed of two minor thirds ...

... #6 is composed of a minor third and a perfect fourth ...

... #7 is composed of a perfect fourth and a minor third ...

... #8 is composed of a perfect fourth and a minor third ...

... #9 is composed of a major third and a minor second ...”

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

“Now, let’s play the C major scale. I will play first then you will play. We will do this only one time. Look and listen ... (demonstration) ... play!”.

Day 17

“Today we will play 4-note phrases. They are written in the keys of D, G, and C major, but not necessarily in that order. All phrases are composed of three intervals. As before I will play the notes first and then you will play them. Look and listen carefully, and adjust your fingers accordingly to play all the notes in tune.

Let’s start with phrase #1. It is composed of a minor third, a perfect fourth, and a minor sixth. Look and listen ... (place the dots on the visual aid and demonstrate) ... play!.” After the students play the teacher will continue: “Look and listen, and adjust your fingers ... (demonstration) ... play!” After the students perform the second time the teacher will continue: “One more time look, listen and adjust your fingers ... (demonstration) ... play!

Phrase #2 is composed of a perfect fourth, a major second, and a minor third ...

... #3 is composed of two minor thirds, and a major third ...

... #4 is composed of a minor second, a major second, and a perfect fourth ...

... #5 is composed of a perfect fourth and two minor seconds ...

... #6 is composed of a minor third, a major sixth, and a minor second ...”

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

“Now, let’s play the D major scale. I will play first then you will play. We will do this only one time. Look and listen ... (demonstration) ... play!”.

Day 18

“Today we will continue playing 4-note phrases in the keys of D, G, and C major but not necessarily in that order. All phrases are composed of three intervals. As before I will play the notes first and then you will play them. Look and listen carefully, and adjust your fingers accordingly to play all the notes in tune.

Let’s start with phrase #1. It is composed of a minor third and two minor seconds. Look and listen ... (place dots on the visual aid and demonstrate) ... play!.” After the students play the teacher will continue: "Look and listen, and adjust your fingers ... (demonstration) ... play!" After the students perform the second time the teacher will continue: "One more time look and listen and adjust your fingers ... (demonstration) ... play!"

Phrase #2 is composed of a minor second and two major seconds ...

... #3 is composed of three minor thirds ...

... #4 is composed of two major thirds and a minor third ...

... #5 is composed of a minor second and two major seconds ...

... #6 is composed of a minor sixth, a minor third, and a perfect fifth ..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now let's play the G major scale. I will play first then you will play. We will do this only one time. Look and listen ... (demonstration) ... play!".

Day 19

"Today we will play more 4-note phrases in the keys of D, G, and C major. All phrases are composed of three intervals. As before I will play the notes first and then you will play them. Look and listen carefully, and adjust your fingers accordingly to play all the notes in tune.

Let's start with phrase #1. It is composed of a major third, and two minor

seconds. Look and listen ... (place the dots on the visual aid and demonstrate) ... play!." After the students play the teacher will continue: "Look and listen, and adjust your fingers ... (demonstration) ... play!" After the students perform the second time the teacher will continue: "One more time look and listen and adjust your fingers ... (demonstration) ... play!

Phrase #2 is composed of a perfect fourth, and two major seconds ...

... #3 is composed of a minor sixth, a minor third, and a minor second ...

... #4 is composed of a major third, a minor sixth, and a minor third ...

... #5 is composed of a minor third, a major second, and a minor second ...

... #6 is composed of a minor third, a major second, and a major third ..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now let's play the C major scale. I will play first then you will play. We will do this only one time. Look and listen ... (demonstration) ... play!".

Day 20

"Today we will continue playing 4-note phrases in the keys of D, G, and C major. All phrases are composed of three intervals. As before I will play the notes first and then you will play them. Look and listen carefully, and adjust your fingers accordingly to play all the notes in tune.

Let's start with phrase #1. It is composed of a major third, a minor third, and a major second. Look and listen ... (place the dots on the visual aid and demonstrate) ... play!." After the students play the teacher will continue: "Look and listen and adjust your fingers ... (demonstration) ... play!" After the students perform the second time the teacher will continue: "One more time look and listen and adjust your fingers ... (demonstration) ... play!"

Phrase #2 is composed of a minor third, and two minor seconds ...

... #3 is composed of a minor sixth, a minor second, and a minor third ...

... #4 is composed of a perfect fourth, a major second, and a minor third ...

... #5 is composed of a perfect fourth and two major seconds ...

... #6 is composed of a perfect fourth and two minor seconds ..."

The same visual demonstration and modeling-imitation procedure will be followed for all intervals. The teacher will remind the students to always look and listen carefully, and to adjust their fingers accordingly to reproduce all the notes as accurately as possible.

"Now let's play all the three major scales. I will play them first, then you will play. Each scale will be played only one time.

let's start with D major ... look and listen ... (demonstration) ... play!.

now let's play G major ... look and listen ... (demonstration) ... play!.

and now C major ... look and listen ... (demonstration) ... play!".

APPENDIX E

TEACHER SCORE OF

DAILY INTERVAL EXERCISES

DAY 1

Introduction of Concetps

On this day the instructor will explain to the students the four main concepts involved in the intonation training:

INTONATION

INTERVAL

HALF-STEP

WHOLE STEP

Instructor will refer to the **Daily Instructional Activities** of the Teacher Manual for step-by-step instructions on how to implement the four intonation concepts listed above. There will be no interval exercises for the students to play on the first day of the instructional phase of the experiment. This is also intended for the students to get used to seeing the instructor perform individual notes or short phases.

Tomorrow, all students need to have their instrument. They must be prepared to start playing the interval exercises. The entire class will be involved in this activity, including cellos and basses.

Score

M.L. Nunez

Score

M.L. Nunez

Score

M.L. Nunez

Score

M.L. Nunez

Score

M.L. Nunez

Score

M.L. Nunez

Score

M.L. Nunez

Score


Score
M.L. Nunez
♩= 88
Violin 1
Viola
Cello
Contrabass
Vln. 1
Vla.
Vlc.
Cb.


Score
♩ = 58
M.L. Nunez
Violin 1
Viola
Cello
Contrabass
Vln. 1
Vla.
Vlc.
Cb.

Score


= 58
M.L. Nunez
Violin 1
Viola
Cello
Contrabass
Vln. 1
Vla.
Vlc.
Cb.
Vln. 1
Vla.
Vlc.
Cb.

Score

M.L. Nunez

Score

Score

Score

Score

Score

M.L. Nunez

Score

M.L. Nunez

INTERVALS

Day 20

Score

Adagio ♩ = 58

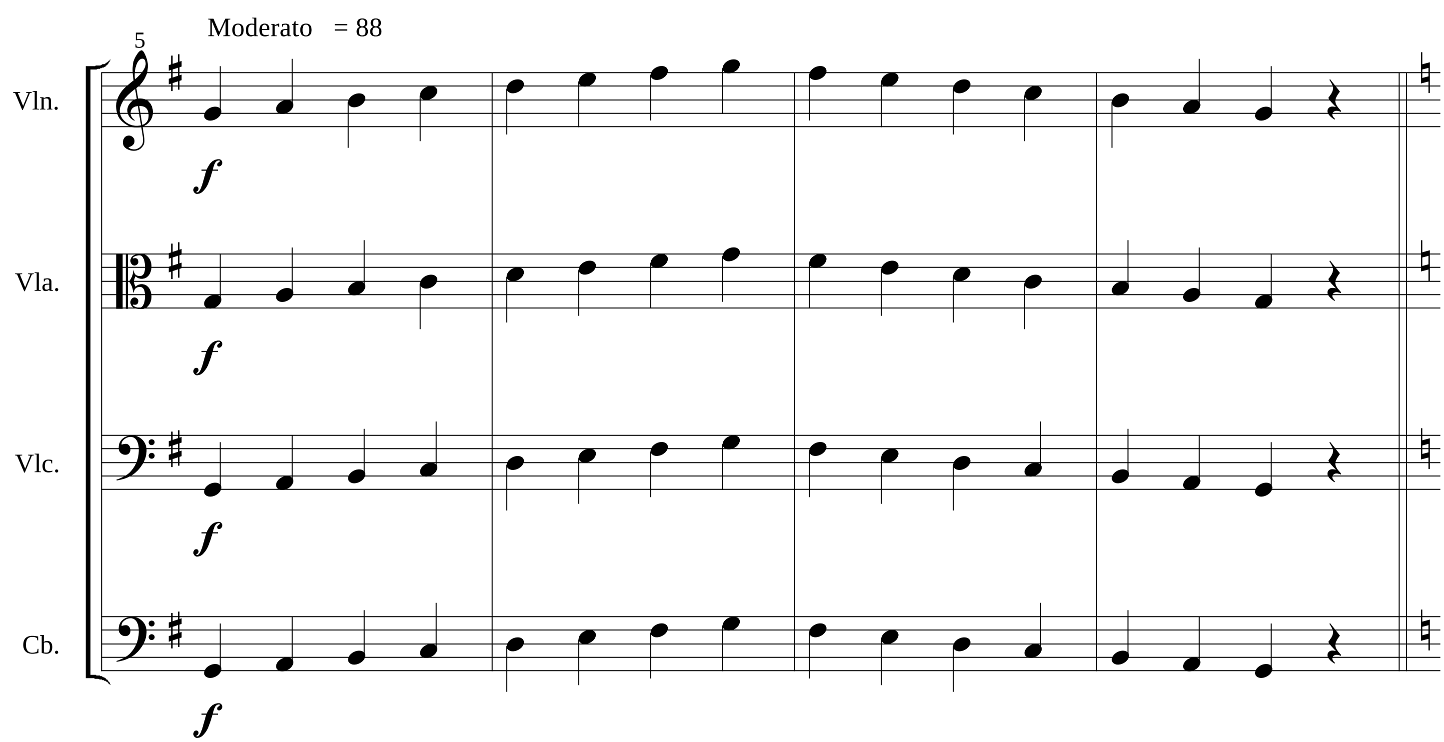
M.L. Nunez

Scales

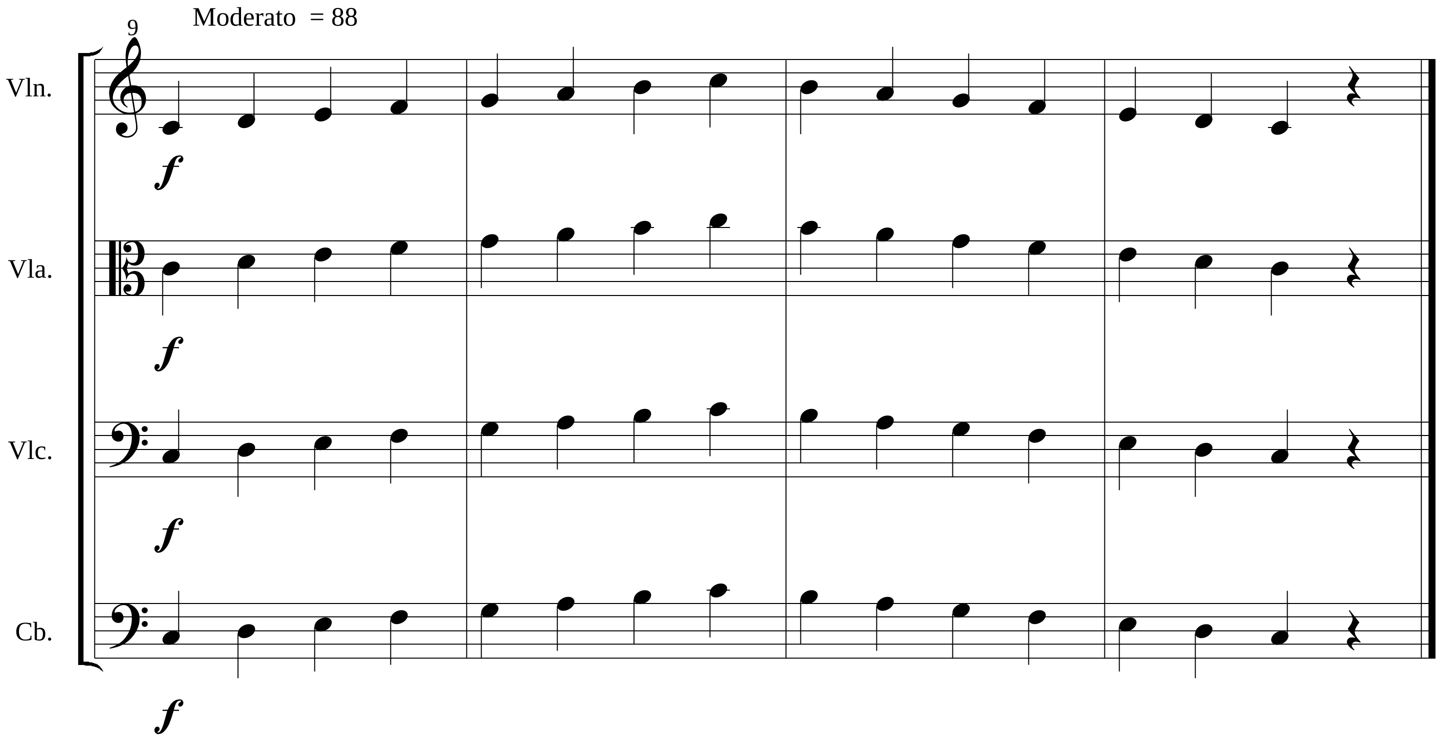
D Major

M.L. Nunez

G Major



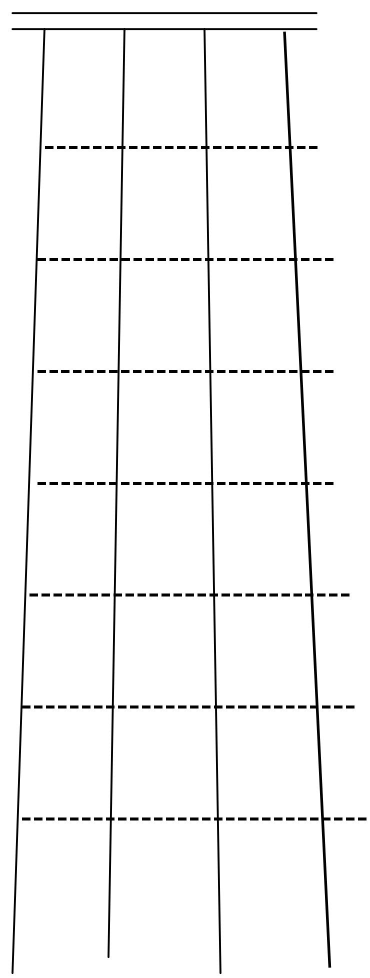
C Major



APPENDIX F

VISUAL AID

VIOLIN OR VIOLA FINGERBOARD



Green dot
Natural notes

Yellow dot
Sharped notes

Blue dot
Flatted notes

Broken lines indicate distance between half steps.

Visual Aid Used in the Implementation of
the Audio/Visual Methodology
instructional activities

APPENDIX G

ABSOLUTE DEVIATION SCORES

AURAL AND AURAL/VISUAL METHODOLOGIES:

PRETEST AND POSTTEST

ABSOLUTE PITCH DEVIATION FROM EQUAL TEMPERAMENT

BY SUBJECT, SINGLE TASK, AND ENTIRE TEST

AURAL EXPERIMENTAL GROUP

Subject: 1 Methodology: Aural Instrument: violin

	Task	1	2	3	4	5	6	7	Absolute deviation Total	Absolute deviation Mean
Prestest	A	10	8	12	--	14	18	16	78	13.00
	B	18	16	13	25	9	22	22	125	17.86
	C	3	0	18	38	46	22	34	161	23.00
						Totals			364	18.20
Posttest	A	8	6	10	--	16	20	14	74	12.33
	B	23	19	15	18	13	21	18	127	18.14
	C	6	8	12	23	28	18	28	123	17.57
						Totals			324	16.20

Subject: 2 Methodology: Aural Instrument: violin

	Task	1	2	3	4	5	6	7	Absolute deviation Total	Absolute deviation Mean
Prestest	A	33	10	18	--	23	31	7	122	20.33
	B	13	3	11	22	29	17	23	118	16.86
	C	50	8	40	48	28	40	40	254	35.29
						Totals			494	24.70
Posttest	A	18	14	21	--	4	10	6	73	12.17
	B	8	10	18	6	4	8	19	73	10.43
	C	8	10	12	18	10	6	14	78	11.14
						Totals			224	11.20

Subject: 3 Methodology: Aural Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	31	38	23	--	14	18	16	160	26.67
	B	35	22	15	20	14	11	1	118	16.86
	C	29	33	52	3	28	10	25	180	25.71
								Totals	458	22.90
Posttest	A	32	26	18	--	16	12	26	130	21.67
	B	31	26	18	14	10	8	4	111	15.86
	C	36	16	28	10	18	12	18	138	19.71
								Totals	379	18.95

Subject: 4 Methodology: Aural Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	25	18	30	--	24	11	30	138	23.00
	B	39	30	14	8	28	21	25	165	23.57
	C	35	20	27	16	5	25	7	135	19.29
								Totals	438	21.90
Posttest	A	18	10	16	--	18	10	16	88	14.67
	B	23	10	18	16	21	13	16	117	16.71
	C	34	14	18	16	10	17	10	119	17.00
								Totals	324	16.20

Subject: 5 Methodology: Aural Instrument: violin

Task		1	2	3	4	5	6	7	Total	Mean
					Pitches					Absolute deviation
Prestest	A	43	35	11	--	26	34	45	194	32.33
	B	20	31	38	42	17	26	10	184	26.29
	C	31	16	36	19	20	21	25	165	23.57
						Totals			546	27.30
Posttest	A	13	21	18	--	18	11	8	89	14.83
	B	16	14	26	16	28	31	18	149	21.29
	C	8	17	9	14	23	11	35	117	16.71
						Totals			355	17.75

Subject: 6 Methodology: Aural Instrument: violin

Task		1	2	3	4	5	6	7	Total	Mean
					Pitches					Absolute deviation
Prestest	A	18	31	28	--	28	31	38	174	29.00
	B	50	54	43	17	26	31	24	245	35.00
	C	39	21	18	33	28	36	31	206	29.43
						Totals			625	31.25
Posttest	A	20	26	18	--	26	37	26	153	25.50
	B	30	36	48	20	22	21	16	193	27.57
	C	40	18	20	21	19	28	33	179	25.57
						Totals			525	26.25

Subject: 7 Methodology: Aural Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	16	32	38	--	21	28	25	160	26.67
	B	3	50	55	18	40	28	33	227	32.43
	C	31	38	27	15	32	50	42	235	33.57
						Totals			622	31.10
Posttest	A	18	28	26	--	24	18	20	134	22.33
	B	10	24	32	20	28	20	16	150	21.43
	C	23	30	29	20	22	18	28	170	24.29
						Totals			454	22.70

Subject: 8 Methodology: Aural Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	32	28	18	--	36	32	41	187	31.17
	B	2	45	28	32	38	26	43	214	30.57
	C	26	22	31	18	33	42	56	228	32.57
						Totals			629	31.45
Posttest	A	22	20	14	--	28	18	76	128	21.33
	B	10	25	23	18	21	28	18	143	20.43
	C	20	22	28	10	18	26	28	152	21.71
						Totals			423	21.15

Subject: 9 Methodology: Aural Instrument: violin

	Task	Pitches								Absolute deviation
		1	2	3	4	5	6	7	Total	Mean
Prestest	A	21	36	18	--	18	26	22	141	23.50
	B	12	18	34	28	38	28	31	189	27.00
	C	33	24	22	42	38	16	31	206	29.43
						Totals			536	26.80
Posttest	A	21	18	23	--	18	23	17	120	20.00
	B	6	10	14	21	31	18	16	116	16.57
	C	16	20	34	24	8	10	12	124	17.71
						Totals			360	18.00

Subject: 10 Methodology: Aural Instrument: violin

	Task	Pitches								Absolute deviation
		1	2	3	4	5	6	7	Total	Mean
Prestest	A	31	36	46	--	37	22	41	213	35.50
	B	22	28	31	18	28	33	31	191	27.29
	C	27	70	41	32	23	28	30	251	35.86
						Totals			655	32.75
Posttest	A	26	28	21	19	--	12	16	122	20.33
	B	20	30	18	10	22	34	23	157	22.43
	C	30	32	28	22	18	20	24	174	24.86
						Totals			453	22.65

Subject: 11 Methodology: Aural Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Absolute deviation Total	Mean
Prestest	A	32	28	36	--	31	26	16	169	28.17
	B	18	32	23	30	41	26	58	228	32.57
	C	22	12	18	38	22	18	32	162	23.14
						Totals			559	27.95
Posttest	A	10	48	21	--	25	41	12	157	26.17
	B	10	8	12	20	18	27	23	118	16.86
	C	8	6	24	65	14	16	12	145	20.71
						Totals			420	21.00

Subject: 12 Methodology: Aural Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Absolute deviation Total	Mean
Prestest	A	23	31	28	--	16	14	24	136	22.67
	B	18	29	28	48	27	28	38	216	30.86
	C	23	18	41	65	23	19	22	211	30.14
						Totals			563	28.15
Posttest	A	18	59	36	--	23	31	29	196	32.67
	B	14	33	18	76	28	31	26	226	32.29
	C	21	18	28	82	10	16	9	184	26.29
						Totals			606	30.30

Subject: 13 Methodology: Aural Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	23	37	18	--	38	28	41	185	30.83
	B	18	21	38	41	31	36	65	250	35.71
	C	21	31	36	41	28	31	28	216	30.86
						Totals			651	32.55
Posttest	A	21	18	16	--	30	36	28	149	24.83
	B	12	18	31	12	10	8	33	124	17.71
	C	18	65	38	35	28	33	21	238	34.00
						Totals			511	25.55

Subject: 14 Methodology: Aural Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	65	75	50	--	65	75	90	420	70.00
	B	12	18	10	21	29	26	18	134	19.14
	C	18	34	38	46	23	18	16	193	27.57
						Totals			747	37.35
Posttest	A	26	38	--	23	14	18	10	129	21.50
	B	22	75	31	28	21	12	18	207	29.57
	C	14	21	28	75	18	16	20	192	27.43
						Totals			528	26.40

Subject: 15 Methodology: Aural Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	38	28	31	--	27	38	45	207	34.50
	B	22	31	28	31	38	75	33	258	36.86
	C	45	18	28	23	18	23	36	191	27.29
						Totals			656	32.80
Posttest	A	24	37	18	--	18	50	20	167	27.83
	B	8	6	10	12	23	37	41	137	19.57
	C	10	14	28	23	14	12	18	119	17.00
						Totals			423	21.15

Subject: 16 Methodology: Aural Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	32	30	14	--	32	45	23	176	29.33
	B	18	27	21	45	45	25	40	221	31.57
	C	23	28	41	38	38	25	48	241	34.43
						Totals			638	31.90
Posttest	A	38	31	41	--	31	23	36	200	33.33
	B	38	32	26	32	23	28	18	197	28.14
	C	21	33	38	41	18	17	24	192	27.43
						Totals			589	29.45

Subject: 17 Methodology: Aural Instrument: violin

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	23	38	43	--	32	47	28	211	35.17
	B	10	18	23	18	26	31	18	144	20.57
	C	18	31	38	31	34	21	38	211	30.14
						Totals			566	28.30
Posttest	A	12	10	6	--	16	45	12	101	16.83
	B	8	6	10	20	16	20	14	94	13.43
	C	18	22	20	26	8	11	14	119	17.00
						Totals			314	15.70

Subject: 18 Methodology: Aural Instrument: violin

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	42	36	28	--	28	85	94	313	52.11
	B	28	36	28	31	27	18	48	216	30.86
	C	22	33	38	33	18	41	32	217	31.00
						Totals			746	37.30
Posttest	A	24	28	45	--	27	18	30	172	28.67
	B	14	18	12	38	18	45	20	165	23.57
	C	12	18	27	33	18	65	20	193	27.57
						Totals			530	26.50

Subject: 19 Methodology: Aural Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	22	28	18	--	33	20	38	159	26.50
	B	32	45	28	31	32	10	18	187	26.71
	C	18	10	14	23	16	27	23	131	18.71
						Totals			477	23.85
Posttest	A	18	26	16	--	12	10	18	100	16.67
	B	22	12	14	45	18	20	35	166	23.71
	C	16	22	31	35	18	31	8	161	23.00
						Totals			427	21.35

Subject: 20 Methodology: Aural Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	23	21	31	--	28	31	45	179	29.83
	B	10	18	8	35	25	15	28	139	19.86
	C	14	9	35	45	11	18	25	157	2243
						Totals			475	23.75
Posttest	A	26	18	22	--	26	18	28	138	23.00
	B	14	13	9	26	19	13	28	122	17.43
	C	12	14	10	24	18	24	22	124	17.71
						Totals			384	19.20

Subject: 21 Methodology: Aural Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	23	14	26	--	45	38	41	187	31.17
	B	18	9	14	36	18	23	41	159	22.71
	C	18	23	26	31	16	19	31	164	23.43
						Totals			510	25.50
Posttest	A	20	18	20	--	32	28	18	136	22.67
	B	15	11	18	26	16	23	25	134	19.14
	C	22	26	18	22	18	14	17	137	19.57
						Totals			407	20.35

Subject: 22 Methodology: Aural Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	18	30	22	--	22	90	18	200	33.33
	B	12	8	14	18	28	22	31	133	19.00
	C	8	11	23	21	25	32	38	158	22.57
						Totals			491	24.55
Posttest	A	16	28	26	--	20	38	20	148	24.67
	B	10	14	13	17	26	21	15	116	16.57
	C	12	8	18	14	26	24	28	130	18.57
						Totals			394	19.70

Subject: 23 Methodology: Aural Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Absolute deviation Total	Mean
Prestest	A	9	27	38	--	28	30	45	177	29.50
	B	52	18	9	38	24	28	19	188	26.86
	C	18	8	12	28	18	22	33	139	19.86
						Totals			504	25.20
Posttest	A	12	34	14	--	37	45	23	165	27.50
	B	14	12	8	38	65	18	14	169	24.14
	C	8	12	18	14	8	10	6	76	10.86
						Totals			410	20.50

Subject: 24 Methodology: Aural Instrument: viola

	Task	Pitches 1	2	3	4	5	6	7	Absolute deviation Total	Mean
Prestest	A	19	28	37	--	29	9	34	156	26.00
	B	31	16	36	42	12	26	21	184	26.29
	C	18	22	32	43	8	36	8	167	23.86
						Totals			507	25.35
Posttest	A	36	29	34	--	12	37	18	166	27.67
	B	45	9	10	21	35	18	12	150	21.43
	C	13	24	5	20	18	12	20	112	16.00
						Totals			428	21.40

Subject: 25 Methodology: Aural Instrument: viola

		Pitches (Absolute deviation)								
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	28	12	18	--	8	12	10	88	14.67
	B	44	33	38	24	37	38	17	231	33.00
	C	44	16	20	7	55	34	3	179	25.57
						Totals			498	24.90
Posttest	A	27	30	17	--	17	39	44	174	29.00
	B	2	8	8	34	17	15	29	113	16.14
	C	28	40	60	45	10	17	4	204	29.14
						Totals			491	24.55

Subject: 26 Methodology: Aural Instrument: viola

		Pitches (Absolute deviation)								
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	28	19	6	--	18	31	25	127	21.17
	B	33	15	30	43	36	38	28	223	31.86
	C	2	33	40	24	14	28	23	164	23.43
						Totals			514	25.70
Posttest	A	37	26	36	--	18	19	5	141	23.50
	B	25	30	44	11	10	22	3	145	20.71
	C	6	3	0	3	25	22	27	86	12.29
						Totals			372	18.60

Subject: 27 Methodology: Aural Instrument: viola

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	10	15	38	--	17	31	22	133	22.17
	B	43	31	43	26	31	28	21	223	31.86
	C	33	7	45	12	49	16	0	162	23.14
						Totals			518	25.90
Posttest	A	34	15	16	--	3	19	12	99	16.50
	B	24	48	26	31	28	32	27	216	30.86
	C	32	38	41	48	46	35	23	263	37.57
						Totals			578	28.90

Subject: 28 Methodology: Aural Instrument: viola

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	30	43	23	--	16	15	7	134	22.33
	B	33	40	18	27	24	31	32	205	29.29
	C	50	25	44	29	65	22	9	244	34.86
						Totals			583	29.15
Posttest	A	51	49	42	--	27	13	34	216	36.00
	B	36	41	21	23	28	18	26	193	27.57
	C	31	24	18	31	18	50	0	172	24.57
						Totals			581	29.05

Subject: 29 Methodology: Aural Instrument: viola

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	7	30	10	--	34	35	17	133	22.17
	B	21	0	32	7	47	10	29	146	20.86
	C	8	18	50	7	10	39	27	159	22.71
						Totals			438	21.90
Posttest	A	37	22	25	--	37	40	23	184	30.67
	B	0	6	27	4	8	7	16	68	9.71
	C	13	11	47	23	18	7	40	159	22.71
						Totals			411	20.55

Subject: 30 Methodology: Aural Instrument: viola

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	28	32	18	--	43	35	12	168	28.00
	B	37	50	12	34	18	28	35	214	30.57
	C	28	37	42	65	34	27	35	268	38.29
						Totals			650	32.50
Posttest	A	22	18	8	--	25	78	8	159	26.50
	B	36	12	22	31	20	47	48	216	38.86
	C	43	18	15	40	46	6	37	205	29.29
						Totals			580	29.00

Subject: 31 Methodology: Aural Instrument: viola

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	50	27	18	--	34	33	37	199	33.17
	B	27	9	42	2	24	12	26	142	20.29
	C	37	44	56	45	28	34	32	275	39.29
						Totals			616	30.80
Posttest	A	48	31	19	--	9	12	48	167	27.83
	B	54	9	28	21	21	5	45	183	26.14
	C	16	14	40	3	16	10	13	112	16.00
						Totals			462	23.10

Subject: 32 Methodology: Aural Instrument: viola

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	16	25	20	--	37	40	28	166	27.67
	B	9	33	17	20	19	34	5	137	19.57
	C	10	12	45	26	38	32	18	181	25.86
						Totals			484	24.20
Posttest	A	32	29	50	--	28	15	11	165	27.50
	B	50	31	24	36	35	12	18	206	29.43
	C	28	33	24	32	33	37	23	210	30.00
						Totals			581	29.05

Subject: 33 Methodology: Aural Instrument: viola

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	31	23	18	--	39	45	32	188	31.33
	B	49	32	42	26	58	34	38	279	39.86
	C	46	36	38	26	11	21	4	182	26.00
						Totals			649	32.45
Posttest	A	10	18	22	--	18	12	14	94	15.67
	B	17	9	3	9	44	50	38	170	24.29
	C	12	20	35	34	13	31	4	149	21.29
						Totals			413	20.65

Subject: 34 Methodology: Aural Instrument: viola

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	28	26	23	--	36	31	26	170	28.33
	B	50	34	38	25	37	17	10	211	30.14
	C	31	25	13	8	34	16	49	176	25.14
						Totals			557	27.85
Posttest	A	22	31	18	--	18	22	45	156	26.00
	B	18	12	26	28	22	35	27	168	24.00
	C	24	51	37	47	12	17	16	204	29.14
						Totals			528	26.40

ABSOLUTE PITCH DEVIATION FROM EQUAL TEMPERAMENT

BY SUBJECT, SINGLE TASK, AND ENTIRE TEST

AURAL/VISUAL EXPERIMENTAL GROUP

Subject: 35 Methodology: Aural/Visual Instrument: violin

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	30	55	52	--	34	28	20	219	36.50
	B	18	21	64	68	3	18	85	277	39.57
	C	50	16	59	75	30	11	65	306	43.71
						Totals			802	40.10
Posttest	A	28	35	31	--	28	21	18	161	26.83
	B	11	17	21	55	21	18	12	155	22.14
	C	18	31	28	41	7	12	16	153	21.86
						Totals			469	23.45

Subject: 36 Methodology: Aural/Visual Instrument: violin

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	10	25	25	--	20	23	28	131	21.83
	B	23	0	33	14	43	50	42	205	29.29
	C	40	19	22	45	52	23	15	216	30.86
						Totals			552	27.60
Posttest	A	23	41	50	--	23	18	20	175	29.17
	B	17	21	36	45	13	21	14	167	23.86
	C	18	16	20	14	8	26	31	133	19.00
						Totals			475	23.75

Subject: 37 Methodology: Aural/Visual Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	34	14	45	--	42	41	34	210	35.00
	B	7	62	20	19	24	58	10	200	28.57
	C	31	3	20	9	53	73	5	194	27.71
						Totals			604	30.20
Posttest	A	23	31	45	--	35	75	50	259	43.17
	B	18	35	21	50	65	28	19	236	33.71
	C	21	25	18	8	14	43	25	154	22.00
						Totals			649	32.45

Subject: 38 Methodology: Aural/Visual Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	37	40	14	--	18	65	24	198	33.00
	B	60	37	20	44	9	45	19	234	33.43
	C	35	15	26	0	30	6	15	127	18.14
						Totals			559	27.95
Posttest	A	22	18	28	--	23	41	18	150	25.00
	B	8	6	12	19	31	26	18	120	17.14
	C	12	15	18	23	6	12	8	94	13.43
						Totals			364	18.20

Subject: 39 Methodology: Aural/Visual Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	38	28	14	--	45	28	0	153	25.50
	B	26	16	31	8	16	2	29	128	18.29
	C	12	18	15	27	28	49	52	201	28.71
						Totals			482	24.10
Posttest	A	11	18	10	--	20	8	14	81	13.50
	B	15	23	14	11	19	12	13	107	15.29
	C	14	22	10	13	8	14	18	99	14.14
						Totals			287	14.35

Subject: 40 Methodology: Aural/Visual Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	24	22	18	--	24	12	18	118	19.67
	B	18	20	16	14	16	0	27	111	15.86
	C	12	14	10	14	24	12	6	92	13.14
						Totals			321	16.05
Posttest	A	20	15	23	--	16	13	17	104	17.33
	B	20	16	18	10	8	4	16	92	13.14
	C	10	16	8	14	18	10	8	84	12.00
						Totals			280	14.00

Subject: 41 Methodology: Aural/Visual Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	17	23	18	--	18	23	36	135	22.50
	B	22	5	40	45	19	12	24	167	23.86
	C	36	20	46	68	17	24	12	223	31.86
						Totals			525	26.25
Posttest	A	13	8	15	--	9	5	10	60	10.00
	B	8	6	10	28	16	7	4	79	11.29
	C	6	10	12	7	18	24	28	105	15.00
						Totals			244	12.20

Subject: 42 Methodology: Aural/Visual Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	32	38	18	--	25	8	13	134	22.33
	B	3	6	25	1	29	7	13	84	12.00
	C	12	64	46	20	20	25	43	230	32.86
						Totals			448	22.40
Posttest	A	17	23	25	--	13	10	12	100	16.67
	B	8	10	12	4	18	6	10	68	9.71
	C	18	28	20	10	20	21	19	136	19.43
						Totals			304	15.20

Subject: 43 Methodology: Aural/Visual Instrument: violin

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	22	24	16	--	73	72	65	272	45.33
	B	20	6	21	35	28	68	72	250	35.71
	C	53	37	51	13	7	15	42	218	31.14
						Totals			740	37.00
Posttest	A	31	21	28	--	23	12	21	136	22.67
	B	12	8	28	31	28	31	28	166	23.71
	C	8	16	23	28	31	14	8	128	18.29
						Totals			430	21.50

Subject: 44 Methodology: Aural/Visual Instrument: violin

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	32	28	18	--	36	30	24	168	28.00
	B	35	28	36	41	23	18	28	209	29.86
	C	28	30	8	32	14	14	23	149	21.29
						Totals			526	26.30
Posttest	A	21	45	18	--	8	45	12	149	24.83
	B	6	9	11	35	31	37	38	161	23.00
	C	8	6	18	45	12	9	6	104	14.86
						Totals			414	20.70

Subject: 45 Methodology: Aural/Visual Instrument: violin

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	28	18	30	--	36	38	32	182	30.33
	B	30	11	21	31	22	3	28	146	20.86
	C	6	41	8	31	30	38	48	202	28.86
						Totals			530	26.50
Posttest	A	22	20	15	--	17	28	23	125	20.83
	B	10	6	18	14	14	10	7	79	11.29
	C	14	8	10	21	34	32	14	133	19.00
						Totals			337	16.85

Subject: 46 Methodology: Aural/Visual Instrument: violin

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	31	49	51	--	28	31	36	225	37.50
	B	5	18	23	42	14	21	34	157	22.43
	C	25	12	0	39	1	29	30	136	19.43
						Totals			518	25.90
Posttest	A	19	27	25	--	20	17	22	130	21.67
	B	10	12	15	21	12	14	18	102	14.57
	C	20	10	6	18	6	17	14	91	13.00
						Totals			323	16.15

Subject: 47 Methodology: Aural/Visual Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	41	23	24	--	34	21	43	195	32.50
	B	15	12	35	24	21	18	32	158	22.57
	C	18	23	26	14	18	31	45	175	25.00
						Totals			528	26.40
Posttest	A	18	14	8	6	10	21	77	12.83	
	B	12	20	18	30	14	40	18	152	21.71
	C	18	43	12	28	31	38	14	184	26.29
						Totals			413	20.65

Subject: 48 Methodology: Aural/Visual Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	23	18	12	--	33	25	30	141	23.50
	B	21	10	35	20	31	8	12	137	19.57
	C	31	48	54	43	13	9	9	207	29.57
						Totals			485	24.25
Posttest	A	24	9	6	17	22	15	93	15.50	
	B	24	16	23	16	19	12	14	124	17.71
	C	28	22	19	8	10	6	12	105	15.00
						Totals			322	16.10

Subject: 49 Methodology: Aural/Visual Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	28	25	28	--	35	1	30	147	24.50
	B	16	46	22	17	33	18	9	161	23.00
	C	1	43	30	39	2	29	0	144	20.57
						Totals			452	22.60
Posttest	A	28	31	17	--	13	28	19	136	22.67
	B	18	38	8	19	26	38	45	192	27.43
	C	23	20	41	38	23	18	12	175	25.00
						Totals			503	25.15

Subject: 50 Methodology: Aural/Visual Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	32	23	26	--	18	31	20	150	25.00
	B	22	17	10	25	21	16	14	125	17.86
	C	26	48	25	17	10	20	12	158	22.57
						Totals			433	21.65
Posttest	A	17	28	18	--	12	8	23	106	17.67
	B	12	8	14	23	38	23	28	146	20.86
	C	12	18	23	32	28	23	12	148	21.14
						Totals			400	20.00

Subject: 51 Methodology: Aural/Visual Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	26	38	20	--	22	25	34	165	27.50
	B	0	42	52	30	11	28	12	175	25.00
	C	0	21	27	13	2	26	21	110	15.71
						Totals			450	22.50
Posttest	A	28	14	8	--	20	18	26	114	19.00
	B	8	23	26	21	14	18	14	124	17.71
	C	12	18	20	10	8	19	20	107	15.29
						Totals			345	17.25

Subject: 52 Methodology: Aural/Visual Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	25	25	18	--	48	24	0	140	23.33
	B	50	19	32	34	18	1	36	190	27.14
	C	10	2	50	40	7	15	21	145	20.71
						Totals			475	23.75
Posttest	A	26	31	39	--	12	41	33	182	30.33
	B	18	8	31	21	41	29	35	183	26.14
	C	26	14	38	8	12	19	22	139	19.86
						Totals			504	25.20

Subject: 53 Methodology: Aural/Visual Instrument: violin

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	25	20	48	--	50	33	15	191	31.83
	B	22	15	31	16	31	10	20	145	20.71
	C	24	8	32	16	56	15	3	154	22.00
						Totals			490	24.50
Posttest	A	28	18	13	--	26	14	20	119	19.83
	B	16	13	23	18	21	6	12	109	15.57
	C	22	14	26	10	31	16	10	129	18.43
						Totals			357	17.85

Subject: 54 Methodology: Aural/Visual Instrument: violin

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	50	35	29	--	43	5	36	198	33.00
	B	7	33	28	6	27	15	24	140	20.00
	C	14	24	37	23	18	29	40	185	26.43
						Totals			523	26.15
Posttest	A	21	18	14	--	23	51	65	192	32.00
	B	8	12	16	23	8	41	14	122	17.43
	C	9	18	45	21	16	12	18	139	19.86
						Totals			453	22.65

Subject: 55 Methodology: Aural/Visual Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	27	27	12	--	29	26	25	146	24.33
	B	46	22	19	32	14	2	21	156	22.29
	C	48	25	28	9	1	24	16	151	21.57
						Totals			453	22.65
Posttest	A	21	18	42	--	8	10	12	111	18.50
	B	12	6	25	31	16	18	20	128	18.29
	C	18	20	28	45	10	12	35	168	24.00
						Totals			407	20.35

Subject: 56 Methodology: Aural/Visual Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	38	40	50	--	58	76	68	330	55.00
	B	39	13	35	38	40	38	55	258	33.86
	C	22	50	22	37	25	32	28	216	30.86
						Totals			804	40.20
Posttest	A	26	38	14	--	10	8	12	108	18.00
	B	4	24	28	18	9	14	16	123	17.57
	C	23	28	31	18	17	18	20	155	22.14
						Totals			386	19.30

Subject: 57 Methodology: Aural/Visual Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	21	22	16	--	22	18	64	163	27.17
	B	14	45	27	28	41	24	46	225	32.14
	C	14	12	42	8	14	45	35	170	24.29
						Totals			558	27.90
Posttest	A	31	21	27	--	23	33	27	162	27.00
	B	14	10	8	21	31	32	34	150	21.43
	C	8	6	10	14	16	28	31	113	16.14
						Totals			425	21.25

Subject: 58 Methodology: Aural/Visual Instrument: violin

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	28	31	45	--	7	45	38	194	32.33
	B	14	25	8	25	47	39	22	180	25.71
	C	26	34	28	9	21	10	17	145	20.71
						Totals			519	25.95
Posttest	A	30	28	20	--	10	26	18	132	22.00
	B	10	23	6	22	18	21	12	112	16.00
	C	8	10	7	22	31	23	10	111	15.86
						Totals			355	17.75

Subject: 59 Methodology: Aural/Visual Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	24	36	38	--	28	33	13	172	28.67
	B	28	0	40	16	31	28	32	175	25.00
	C	6	3	15	24	4	41	28	121	17.29
						Totals			468	23.40
Posttest	A	18	80	26	--	31	65	30	250	41.67
	B	21	40	10	27	35	28	31	192	27.43
	C	18	55	45	75	12	16	20	241	34.43
						Totals			683	34.15

Subject: 60 Methodology: Aural/Visual Instrument: violin

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	26	32	36	--	45	38	28	205	34.17
	B	38	11	24	23	46	45	11	198	28.29
	C	38	19	24	23	26	35	17	182	26.00
						Totals			585	29.25
Posttest	A	31	28	46	--	18	33	21	177	29.50
	B	18	28	31	28	40	18	35	198	28.29
	C	23	28	41	21	18	31	12	174	24.86
						Totals			549	27.45

Subject: 61 Methodology: Aural/Visual Instrument: violin

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	45	52	38	--	42	38	41	256	42.67
	B	16	49	31	23	32	15	64	230	32.86
	C	21	26	28	75	21	2	18	191	27.29
						Totals			677	33.85
Posttest	A	18	23	19	--	8	12	23	103	17.17
	B	18	26	12	31	16	45	12	160	22.86
	C	21	13	19	28	18	12	23	134	19.14
						Totals			397	19.85

Subject: 62 Methodology: Aural/Visual Instrument: viola

		Pitches							Absolute deviation	
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	20	38	7	--	23	31	56	175	29.17
	B	29	15	41	3	29	0	75	192	27.43
	C	21	11	4	19	18	20	18	111	15.86
						Totals			478	23.90
Posttest	A	18	25	37	--	46	25	10	161	26.83
	B	22	12	18	26	45	31	12	166	23.71
	C	18	17	9	16	18	12	8	98	14.00
						Totals			425	21.25

Subject: 63 Methodology: Aural/Visual Instrument: viola

	Task	Pitches							Absolute deviation	
		1	2	3	4	5	6	7	Total	Mean
Prestest	A	50	7	17	--	60	9	4	147	24.50
	B	3	15	28	24	38	51	9	168	24.00
	C	38	13	39	37	12	19	0	158	22.57
						Totals			473	23.65
Posttest	A	16	28	19	--	32	26	50	171	28.50
	B	12	31	26	36	12	35	32	184	26.29
	C	21	15	18	36	31	18	21	160	22.86
						Totals			515	25.75

Subject: 64 Methodology: Aural/Visual Instrument: viola

	Task	Pitches							Absolute deviation	
		1	2	3	4	5	6	7	Total	Mean
Prestest	A	53	49	33	--	16	17	37	205	34.17
	B	3	1	23	80	38	8	63	216	30.86
	C	14	17	42	24	50	35	14	186	28.00
						Totals			617	30.85
Posttest	A	12	8	10	--	10	18	12	70	11.67
	B	0	28	42	30	24	18	40	182	26.00
	C	18	24	32	18	3	45	12	152	21.71
						Totals			404	20.20

Subject: 65 Methodology: Aural/Visual Instrument: viola

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	48	5	25	--	26	43	26	173	28.83
	B	40	18	9	56	4	18	34	179	25.57
	C	20	2	43	65	45	0	0	175	25.00
						Totals			527	26.35
Posttest	A	21	16	8	--	26	12	8	91	15.17
	B	18	32	16	21	8	27	9	131	18.71
	C	23	18	27	32	8	45	12	165	23.57
						Totals			387	19.35

Subject: 66 Methodology: Aural/Visual Instrument: viola

		Pitches								Absolute deviation
	Task	1	2	3	4	5	6	7	Total	Mean
Prestest	A	23	14	5	--	24	30	9	105	17.50
	B	44	46	4	10	20	10	19	153	21.86
	C	63	73	10	18	06	31	25	226	32.29
						Totals			484	24.20
Posttest	A	16	32	38	--	28	42	8	164	27.33
	B	18	12	26	12	32	41	12	153	21.86
	C	17	27	33	21	22	54	38	212	30.29
						Totals			529	26.45

Subject: 67 Methodology: Aural/Visual Instrument: viola

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	14	5	20	--	36	7	9	91	15.17
	B	16	27	8	63	2	2	43	161	23.00
	C	10	43	27	18	20	22	13	153	21.86
						Totals			405	20.25
Posttest	A	17	12	19	--	14	23	48	133	22.17
	B	13	18	23	26	35	75	25	215	30.71
	C	20	8	34	17	43	10	3	135	19.29
						Totals			483	24.15

Subject: 68 Methodology: Aural/Visual Instrument: viola

	Task	Pitches 1	2	3	4	5	6	7	Total	Absolute deviation Mean
Prestest	A	19	21	5	--	36	3	21	105	17.50
	B	48	20	22	22	10	1	26	149	21.29
	C	3	19	43	7	3	58	40	173	24.71
						Totals			427	21.35
Posttest	A	23	18	24	--	31	16	20	132	22.00
	B	18	12	22	31	41	16	11	151	21.57
	C	8	6	14	28	19	26	18	119	17.00
						Totals			402	20.10

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